THE EFFECT OF BLOOMING DATE ON THE RETENTION AND FIBER PROPERTIES OF BOLLS IN SIX VARIETIES OF COTTON, *GOSSYPIUM HIRSUTUM* L.

By

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CHAPTER I

INTRODUCTION

Experiments to determine relative varietal performance for characters of interest are routinely conducted in all of the major crops including cotton, *Gossypium hirsutum* L. Bridge, Meredith, and Chism (13) have stated that the evaluation of cotton varieties is a continuous process because new varieties are periodically released, cultural practices are modified, and new plant types are needed to compensate for changing circumstances. They suggested that most successful varieties have an average use of about 10 years.

In the past, lint yield was the major yardstick in the breeding and evaluation of new cotton varieties. Fiber properties were given little attention; but gradually, the importance of characters other than yield has been recognized. Increased competition from synthetic fibers had no small part in bringing about that recognition. Today, cotton breeders are striving to release varieties with higher fiber quality, and a number of such varieties have been released in recent years (e.g., 'Tamcot 788', 'Deltapine 16', and 'Paymaster 111A').

One of the primary factors responsible for considerable variation in boll characteristics and fiber properties within a variety of cotton is the long flowering and fruiting period of the plant which in most areas of the Cotton Belt extends from 6 to 10 weeks (26). This provides the environment with a prolonged opportunity to influence the characteristics of the fiber produced.

The present study was conducted to test the effect of blooming date on the retention of bolls and on their performance for selected fiber properties. Since differences in response among varieties were probable, six varieties of American upland cotton, *Gossypium hirsutum* L., were utilized in the study; four of the six varieties were released by the Oklahoma Agricultural Experiment Station while the other two were released by commercial firms.

CHAPTER II

REVIEW OF LITERATURE

To permit greater comprehension of the previous research, this chapter is subdivided into categories by traits studied.

Flowering and Fruiting Habits

Buie (14) stated that cotton begins fruiting in South Carolina 8 to 11 weeks after planting and continues until frost. The plant requires 6 to 8 weeks after flowering to develop open, mature bolls. He published weekly fruiting data in which the curve describing flower numbers went up slowly at first, then rose rapidly reaching its maximum peak some 5 to 6 weeks after fruiting began, and then declined rapidly over the next three weeks. Ewing (21) also examined flowering trends in Mississippi and showed that the number of flowers increased slowly at first to a peak, leveled off, and then declined. Therefore, flowering can be divided into three major periods of time. Fibers obtained from each period may exhibit different fiber properties dependent, at least to some extent, on the prevailing environmental situation during these periods. He also concluded that the percentage of shedding is higher in early and rapid flowering varieties and that varieties which flower somewhat later with less rapidity and less shedding are more efficient in the production of lint. Hancock (26) in Tennessee also divided the flowering period to three parts; i.e., an ascending period, the first three weeks; a peak period, the next two weeks or ten days; and a descending period, the remainder of the season. Meredith and Bridge (39) noted in Mississippi that a high percentage of the early flowering buds reach maturity and that the peak point of flowering occurs approximately four weeks after first bloom. Then, the production of squares decreases rapidly; and the abscission rate for young squares and bolls increases. They stated that in the early blooming season temperature, sunlight, moisture, and mineral nutrition levels are high; and as a consequence, bolls have good environmental conditions for growth and retention. With the advancing season, night temperature lowers, sunlight lessens, and moisture and nutrients decrease; thus, the quality and quantity of bolls retained also decreases.

Mauney (37) suggested that day temperature, like night temperature, could affect flowering behavior. He observed that high day temperatures caused flowers to initiate earlier than usual even though night temperatures in the same period of time were low. Fisher (23) in Arizona obtained negative correlations between boll set and minimum temperature. Hoffman and Rawlins (30) reported that boll set was negligible at 21% and 91% constant relative humidities with a maximum temperature of 38 C and a minimum of 26 C because the anthers did not dehisce. However, relative humidities of 40% and 65% allowed good boll set. Meyer (41) detected a highly significant positive correlation between maximum temperature and percent sterile anthers in flowers which opened 15 to 16 days later. She found that as maximum temperatures became higher than 32 C, homozygous male sterile plants produced nearly 100% sterile anthers and heterozygous plants in maximum temperatures above or around 38 C gave completely sterile anthers. Mauney and Phillips (38) showed that floral initiation was delayed by high night temperatures.

Stockton, Doneen, and Walhood (50) stated that irrigation approximately 30 days prior to anthesis influenced the rate of flowering. They suggested that total flower production increases when the number of irrigations is increased. Howard, Ehlig and LeMert (20) found that irrigation dates did not have a significant influence on the flowering cycle. Bilbro (12) showed under different soil mositures that the varieties he tested had distinct fruiting habits and that different soil moisture levels did not significantly influence their fruiting patterns.

Shedding

Munro (43) suggested that one of the main characters affecting earliness is the shedding of fruiting parts from the plant, either before or after flowering. He felt that environmental factors were more important in this regard and overshadowed the varietal (i.e., heritable) differences; but that when conditions favored shedding, the latter factor would be distinguishable. Tharp (51) asserts that most square shedding occurs before opening of the blooms and that factors such as drought, extremes in temperature, cloudy weather, and insect and disease damage can cause shedding. He suggested a delayed response of 36 hours to 10 days after the effective injury before the shedding actually takes place with most shedding occurring approximately 7 days after blooming. Shedding for bolls after 10 days is rare unless a shock occurs such as water stress, frost, or chemical treatments.

Stockton et al. (50) cited causes for boll shedding as being related to temperature, soil moisture, insect injury, and plant nutrients.

The effect of soil moisture on boll shedding has been tested by several investigators who, by their conclusions, can be categorized into two groups: those who suspect high moisture as increasing shedding [e.g., King (32), Dunlap (18), Christidis and Harrison (15), and Albert and Armstrong (4)], and those who believe that low moisture increases shedding [e.g., Beckett and Dunshee (11), Adams, Veihmeyer, and Brown (2), and Spooner, Caviness, and Spurgeon (48)]. Both positions probably fit the situations observed. Crowther (16) has suggested that although high soil moisture produces more flowers, the least total shedding is actually obtained when soil moisture is at a medium (i.e., an optimum) condition. Dunlap (18) has determined that shedding is assured when the plant is subjected to continuous wilting for a few days (more than two); the weather is cloudy; the temperature is 100 F or higher; and the soil is flooded. Balls and Holton (10) observed that before irrigation, shedding was greater than at other periods and in Egypt it became excessive when the rise of the Nile saturated the lower rootzone. Stockton et al. (50) found that increasing the number of irrigations increased the amount of shedding.

Ehlig and LeMert (20) did not find direct relationships between low boll retention and high temperature or high relative humidity. However, they did suggest a time interval of 1 to 3 weeks between the occurrence of the high temperatures and the appearance of the low boll retention. They were unable to detect any relationship between irrigation and boll retention rate. Mauney and Phillips (38) observed that night temperatures of 30 C caused shedding in many species of *Gossypium*.

Harland (28) found that the highest amount of shedding occurs at the time of heavy rainfall. Lloyd (34) concluded that rainfall near mid-day caused a high degree of boll shedding presumably because it destroyed pollen. Mason (36) noted that at later periods of plant development and after humid and dark days generally with a lot of rain, shedding rates became greater than at other times. He also observed heavy shedding after defoliation.

Buie (14) stated that up to 50% of the immature bolls may be shed under normal conditions and that many factors affect the variation of this percentage, including soil moisture. He also noted that although fruiting is not rapid in the first 3 weeks, the probability of a square producing a boll is greater in this period. Therefore, fewer flowers during the earlier part of the flowering season are more effective than more, but later, flowers. Adcock (3) noted that later maturing varieties produced fewer mature bolls in Oklahoma. Eaton and Ergle (19) demonstrated that if the mechanism of boll shedding did not occur, the cotton plant would over-fruit and produce smaller bolls with poorer fiber.

Tollervey (52) stated that yield was not limited by the number of fruiting points produced, but that it was due to increased shedding under high plant density. He enumerated two hypotheses for the causes of shedding, i.e., the limitation of carbohydrate and the role of hormones. Hawkins, Matlock, and Hobart (29) noticed that too high or too low vegetative growth was accompanied by an increase in boll shedding. They tested the levels of carbohydrate in cotton plants in Arizona under different levels of water supply and concluded that the amount of plant nutrients available controls the percentage of shedding.

Fiber Length

Hanson, Ewing, and Ewing (27) determined that several climatic factors during the period of July 6 - August 23 were closely associated with differences in fiber length. They showed that the ranges in maximum and minimum temperature and in rainfall during the period of fiber elongation were the most important. Tharp (51) described the elongation process in cotton fiber and mentioned that it is affected by environmental factors such as water shortage and temperature, but that it is largely a varietal characteristic within a given environment. He also stated that high daily average temperature and low soil moisture results in shorter fibers. Armstrong and Bennett (8) noted that it is a commonly accepted fact among cotton growers that varieties produced shorter lint in dry seasons.

Gipson and Joham (24) demonstrated that the relationship between fiber length and night temperature is parabolic rather than linear. Maximum length was obtained between 15 and 21 C, with reductions occurring at temperatures above or below that range. Jackson and Faulkner (31) showed that fiber elongation in Egyptian cotton (G. barbadense L.) is usually completed during the first month after flowering and that lower maximum temperatures during that time will result in shorter fibers. A USDA report (17) stated that the factors influencing fiber length would be effective only for a period of 20 or so days after blooming. Meredith, Bridge, and Chism (40) using four varieties concluded that on the average, the third harvesting date (out of 10) yielded the longest fiber over all varieties and after that time, fiber length steadily decreased throughout the remainder of the season.

Staten (49) found that early and midseason bolls produced longer fibers than did the later ones. Hancock (25) and Rajaraman and Afzal (47) showed that the last picking gave shorter fibers than did the first. Hancock (27) observed that the varieties 'Stoneville 2' and 'Trice 90-1' produced their longest fibers during the second of three periods of flowering time. Armstrong and Bennett (9) noted that even on a single plant, bolls from blooms which opened on two successive days could exhibit distinguishable differences in length. Finley and Phillips (22) found, after five weeks of defloration, that the length of fiber increased slightly. Murray and Verhalen (45) have calculated a positive correlation of 0.37 between fiber length and earliness.

Bilbro (12) noted that fiber length decreased from Sept. 3 to Nov. 12; and after that, it increased slightly. However, fibers harvested last were the shortest of the whole season. He did not obtain significant length differences between different soil moisture regime. Similar results were described for another measure of fiber length. Meredith and Bridge (39) found that fibers were longer before "cut out" than after.

Abou-El-Fittouh, Rawlings, and Miller (1) showed that temperature was the major cause for genotype by environment interactions in fiber length. Other environmental variables (e.g., elevation, moisture, insects, diseases, and fertilizers) were associated with only minor portions of the interactions observed. In Oklahoma, Murray and Verhalen (46) detected a small, but significant, genotype by year interaction for fiber length. The genotype by location and three-factor interactions for that trait were not significant.

Uniformity of Fiber Length

Staten (49) found the fiber from late-matured bolls to be slightly less uniform than from early and midseason bolls. Armstrong and Bennett (9) demonstrated that length uniformity can differ for fibers from bolls which bloomed on two successive days on a single plant. Meredith and Bridge (39) showed that uniformity was greater in the period before "cut out" than in the period after.

Fiber Strength

Adcock (3) observed that bolls from early blooms under favorable conditions had stronger fibers. Hancock (26) showed in two varieties of cotton that fiber strength was at a maximum when the fiber came from bolls developed in the first flowering period.

Meredith and Bridge (39) found that yarn and fiber strength were affected by changing climatic conditions in that yarn and fiber were weaker at the two last harvests. Meredith et al. (40) showed that the third harvest (out of 10) yielded the highest fiber strength. Strength decreased sharply at the two weekly harvests following that maximum point. They pointed out that sudden reductions in temperature in the early stage of fiber development decreased the strength of the fiber. Bilbro (12) found the fiber from his first harvests to be significantly stronger than that from later harvests. Different moisture level treatments did not influence signficant differences in fiber strength. Meyer and Meyer (42) found that a doubled haploid strain, M8, did not exhibit significant strength differences between soil changes and water treatments, but that variation was highly significant between harvest dates and for the water treatment by date interaction.

Gipson and Joham (24) obtained primarily negative regressions between fiber strength and night temperature during the development of the fiber. Tharp (51) stated that high average daily air temperatures caused stronger fibers. He also suggested that some water stress in later periods of growth induced stronger fiber. Hanson et al. (27) calculated positive regressions for fiber strength on maximum, mean, minimum, and maximum minus minimum temperatures and on percent possible sunshine. Mean monthly rainfall exhibited a negative regression with strength. All relationships, except that for minimum temperature, were significant.

Finley and Phillips (22) found that fiber strength increased after five successive weeks of defoliation.

Murray and Verhalen (46) detected a significant, though small, estimate of genotype by year interaction for fiber strength (measured as T_1). The other interactions involving genotypes and environments were not significant for this trait. For another measure of fiber strength (i.e., T_0), none of the interactions were significant.

Fiber Fineness

Hancock (26) found maximum fineness in the fibers from the last part of the flowering period. Bilbro (15) showed that micronaire increased fairly consistently up to the early days of November and that it decreased rapidly thereafter. Soil moisture treatments did not have a significant effect on fineness values.

Meredith et al. (40) determined that differences among varieties for micronaire during the earlier harvests were greatest and that the differences, in general, became progressively smaller for the later harvests. Meredith and Bridge (32) have also shown that the early harvests produced higher micronaire values than later harvests and that micronaire decreased steadily throughout the season. Meyer and Meyer (42) were unable to detect significant effects on fiber fineness for water treatment or water treatment by harvest date sources of variation, but they did find significant harvest-date variation.

Abou-El-Fittouh et al. (1) showed that temperature was the environmental factor tested which had the greatest influence in general on cotton but that it had minimal influence on fineness. However, the influence of night temperature on fiber fineness was tested by Gipson and Joham (24), and they concluded that fineness was affected more by night temperature than were the other physical properties of the fiber. By decreasing night temperature, micronaire was decreased; the relationship between the two variables being linear. Tharp (51) suggested that as average daily temperature goes higher, the fibers produced become coarser. Murray and Verhalen (46) calculated a significant and large second-order interaction for fiber fineness in Oklahoma. The first-order interactions for this trait were not statistically significant.

CHAPTER III

MATERIALS AND METHODS

This research was conducted at the Agronomy Research Station, Perkins, Oklahoma, on a Vanoss loam soil from 1968 through 1970. Temperature records for the growing seasons in question are provided in the Appendix in Figures 27, 28, and 29, respectively; while the corresponding rainfall amounts are shown in Figures 30, 31, and 32, respectively. Six commercial varieties of upland cotton, *Gossypium hirsutum* L., were included in the experiment. Those varieties are identified as follows:

A. 'Lockett 4789-A' (7) was developed by a private concern (Lockett Seed Company, Vernon, Texas) and released in 1968. The variety is described as being suitable for areas which require early maturing varieties. Under both dryland and irrigated conditions, it yields well; its bolls are storm resistant and large; and its plant is close fruiting (i.e., semicluster). Its fiber strength is above 85,000 PSI; length is approximately 1 1/32 inches and longer; and fineness ranges between 3.7 and 4.~~5~~9 micronaire units.

B. 'Stoneville 7A' (35) was developed and released by a private company (Stoneville Pedigreed Seed Company, Stoneville, Miss.). This variety has good tolerance to verticillium wilt (*Verticillium albo-atrum* Reinke and Berth.), has a fair level of tolerance to bacterial blight [*Xanthomonas malvacearum* (E. F. Sm.) Dows.], but is susceptible to the fusarium wilt [Fusarium oxysporum Schlecht f. vasinfectum (Atk.) Snyder and Hanson] and root-knot nematode (Meloidogyne incognita var. acrita Chitwood) complex. Its maturation rate is about average, and its plant height is average in the mid-South. Bolls are on the small side with small seed, but the seed does have good emerging quality. Its bolls are classified as open under Oklahoma conditions. Fiber length is longer than average (1 1/16 to 1 1/8 inches), strength is good, and fineness tends toward coarseness in the Mississippi Delta in some years.

C. 'Kemp' (5) was developed by the Oklahoma Agricultural Experiment Station, Stillwater, Oklahoma, from a cross between 'Stoneville 62' and 'Stoneville 20' with five subsequent backcrosses to Stoneville 62. It was released in 1964. The variety is like Stoneville 62 but has the advantage of resistance to bacterial blight. It is early in maturity; it has an open plant medium in size; but its bolls are not storm resistant. On dryland and under irrigation, it yielded more than did Stoneville 62. It also has longer, stronger, and finer fibers than Stoneville 62 and a higher lint percent.

D. 'Verden' (6) was developed by the Oklahoma Agricultural Experiment Station, Stillwater, Oklahoma, using single plant selection primarily for resistance to bacterial blight in a population of 'Northern Star'. The variety was released in 1964. Verden is an open, branching-type cotton with a strong main stem, and its fruiting branches are medium in length. It is medium early in maturity and has large, fluffy, open bolls. It has yielded well in Oklahoma under dryland and irrigated conditions. Compared with a variety more commonly grown, Verden displayed longer and stronger fiber with a higher lint percent. The two varieties were essentially equal in fiber fineness.

E. 'Lankburn' (33) was derived from a cross between 'Lankart 57' and 'Auburn 56' by the Oklahoma Agricultural Experiment Station, Stillwater, Oklahoma, and released in 1967. In comparisons with Lankart 57, Lankburn has a longer fiber; but it is later in maturity and has a lower lint percent. Both varieties have a storm resistant boll and a fiber with the same degree of strength and fineness. Lankburn is resistant to the fusarium wilt, root-knot nematode complex, but is susceptible to bacterial blight and verticllium wilt while Lankart 57 is susceptible to all three diseases.

F. 'Westburn' (44) was bred from a cross (between Auburn 56 and 'Western Stormproof') made by the Oklahoma Agricultural Experiment Station, Stillwater, Oklahoma, and released in 1967. In comparisons with 'Auburn M' (an earlier selection out of Auburn 56 by the Missouri Agricultural Experiment Station, Portageville, Missouri), Westburn was higher yielding and had a stormproof instead of an open boll. Auburn M displayed longer, coarser fiber than did Westburn. Compared to Lankart 57, Westburn was higher yielding, was earlier in maturity, and had a more stormproof boll with a longer fiber; but Lankart 57 had a higher lint percent and coarser fiber. Westburn is resistant to the fusarium wilt, root-knot nematode complex, has only a slight tolerance to verticillium wilt, and is susceptible to bacterial blight.

Each year 2 to 4 weeks before planting, 200 pounds of 10-20-10 fertilizer/acre were applied to the test area. The experiment was planted on May 31, May 26, and May 26 in 1968 through 1970, respectively. The experimental design employed was a randomized complete-block with six entries (varieties) and two replications. A different randomization was used each year. Plots were four rows wide with rows 36 feet long and 40 inches apart. The distance between successive plants within a row was thinned to approximately 12 inches (37 plants/row) on June 20, June 11, and June 15 in the three years, respectively. Six treatments for insect control in 1968, none in 1969, and four in 1970 were required. Approximately two inches of water were applied at the only irrigations in 1968 and 1970 on August 5-8 and August 11-14, respectively. No irrigations were made in 1969. In short, all cultural practices such as cultivation, irrigation, weed and insect control, etc., were conducted as required.

Each Monday morning throughout the flowering season, all blooms that were open in the experiment, would open that day, or had opened the previous day were tagged. Tags were coded so that tagging dates could be differentiated at the end of the season. Records were kept of the number of tags/row/tagging date.

Harvesting was accomplished by hand after frost on November 23, November 22, and November 20 on the three consecutive years. At harvest, each tagging date for each row was kept separate. Counts of bolls set/row were made. A boll was considered set if it had one or more locks of fluffy seed cotton. Then, the percentage was calculated for tagged flowers which had set mature bolls. The seed cotton from each row and tagging date was then ginned separately on an 8 saw, laboratory-type gin. The seed were discarded, and the fiber samples were sent to the Fiber Laboratory at Oklahoma State University, Stillwater. The fiber properties measured were 2.5% span length, 50% span length, uniformity index, 1/8-inch gauge stelometer, and micronaire. These measurements are defined as follows:

1. 2.5% Span Length - the length in inches at which 2.5% of the fibers (when caught at random along their length) are of that length or longer as measured on the digital fibrograph,

2. 50% Span Length - the length in inches at which 50% of the fibers (when caught at random along their length) are of that length or longer as measured on the digital fibrograph,

3. Uniformity Index - the ratio of 50% to 2.5% span length expressed as a percentage,

4. 1/8 Inch Gauge Stelometer (T_1) - the strength in grams per grex of a bundle of fibers as measured on the stelometer with the two jaws (separated by a 1/8-inch spacer) holding the fiber bundle, and

5. Micronaire - the fineness in standard micronaire units as measured on the micronaire (an air-flow instrument).

There were seven tagging dates in 1968 and 1970 and six in 1969. The plants in 1969 were apparently a week earlier in maturity; and although the tagging 1969 was started on the same calendar date as in 1968 and 1970 (plus or minus a day), the rate of blooming was well underway at the first tagging. In 1968 and 1970, blooms at the first tagging dates were few. As a consequence, the first tagging date in 1969 (considering the growth stage of the plants) was judged to be equivalent to the second date in each of the other years. To prevent possible bias in the statistical analysis as a result of an unbalanced design, the first date of tagging in 1968 and 1970 was eliminated for all characters under study. Since blooms at the first dates in those two years were few, little data were discarded, and loss of information was minimal. When measuring the fiber properties in the laboratory, it was found that most samples did not have sufficient fiber on the last tagging date (i.e., date seven) for readings to be obtained. Therefore, statistical analysis for the fiber properties were run for dates two through six. For the boll retention characters, i.e., number of blooms tagged (NBT), number of bolls set (NBS), and percentage bolls set (PBS), dates two through seven were analyzed. In the analysis of NBT, NBS, and PBS, the four original subsamples/plot were studied separately; but since many of the subsamples for the fiber properties did not have sufficient fiber to be measured in the laboratory, plot means of available subsamples (one to four for each plot), were used for analyses.

CHAPTER IV

RESULTS AND DISCUSSION

To present the results of this investigation more clearly, this chapter is divided into sections by characters studied.

Flowering Characters

Main Effects for NBT, NBS, and PBS

In this section, the flowering characters, numbers of blooms tagged (NBT), number of bolls set (NBS), and percentage bolls set (PBS) are reported. Table 1 provides the analyses of variance for these three characters. All main effects and interactions were significant for all characters, except for the year X variety mean squares for NBS and PBS. Figure 1 shows the mean performance of these characters by tagging dates over varieties and years. NBT gradually increased until the middle of the season, then declined. This distribution is in general agreement with most previous investigations on the subject (14, 21, 26, 39). NBS increased to a maximum at date three (earlier in the season than NBT); and after that, it exhibited a more-or-less continuous decline to the end of the season. This suggests that the setting of blooms as bolls is most effective in the early part of the season. After 2 to 3 weeks of blooming, the absolute number of blooms set begins to decline. For both NBT and NBS, a slight drop can be detected

TABLE I

ANALYSES OF VARIANCE FOR NBT, NBS, AND PBS

Source	df	Mean Squares		
		NBT	NBS	PBS
Year	2	6883**	1787**	10682.96**
Rep (Year)	3	164	30	340.09
Variety	5	8403**	1294**	3005.83**
Year X Variety	10	1122*	111	440.53
Rep X Variety (Year)	15	352	104	278.62
Date	5	33600**	12113**	94996.74**
Year X Date	10	13154**	3768**	6635.02**
Rep X Date (Year)	15	320	49	464.65
Variety X Date	25	1059**	464**	457.20**
Year X Variety X Date	50	576**	135**	251.17*
Rep X Variety X Date (Year)	75	199	68	142.31
Sample (Year, Rep, Variety, Date)	648	182	39	128.46
Corrected Total	863	655	186	825.27

*, ** Significant at the 0.05 and 0.01 levels of probability, respectively.

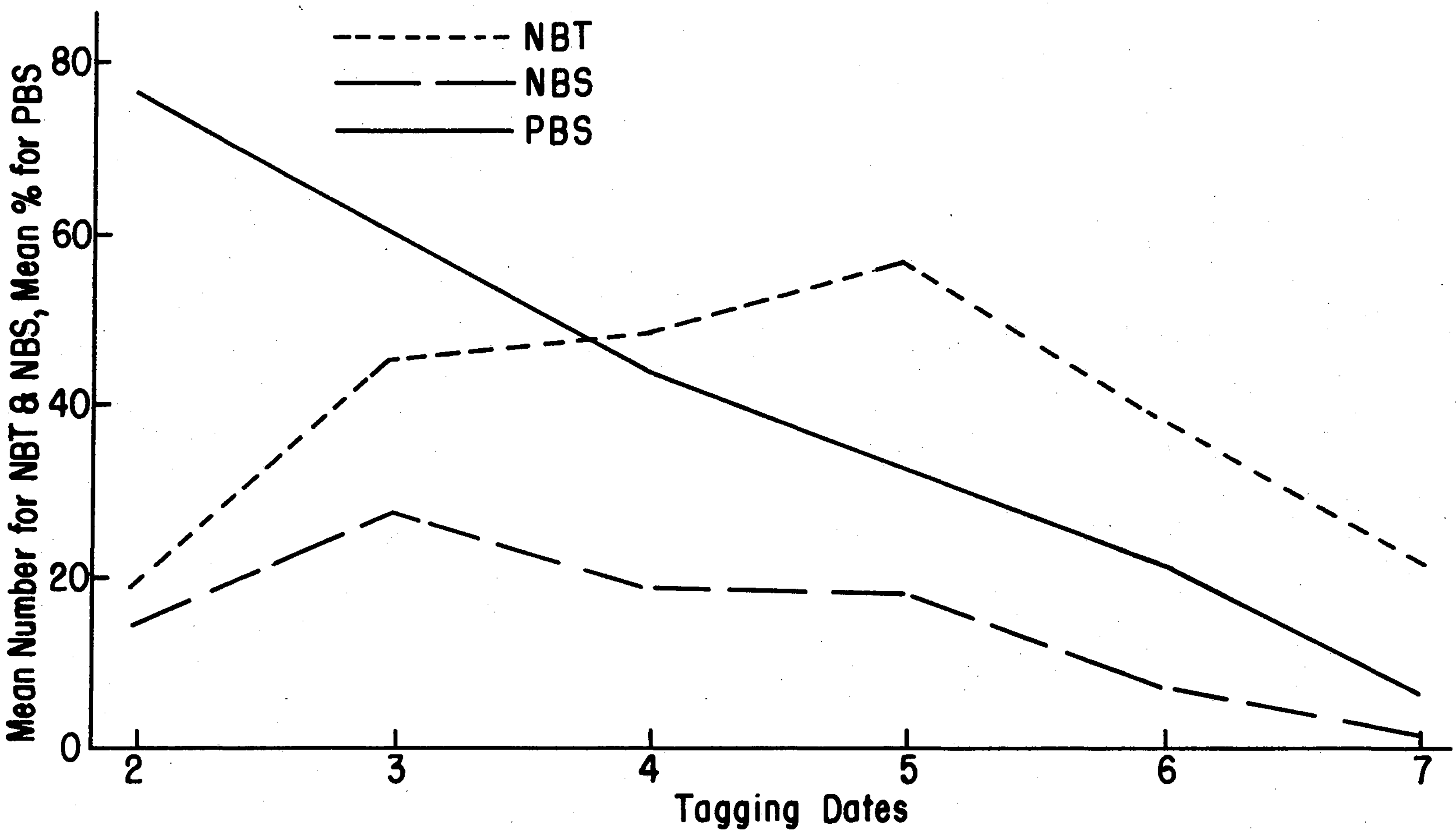

Figure 1. Mean Performance Over Varieties and Years for NBT, NBS, and PBS by Tagging Dates

in the mean for date four. The decrease in mean NBT was caused by a drop in NBT for certain varieties, but not others, in 1968 at that tagging date. The reason or reasons are unknown. Neither rainfall, maximum or minimum temperature, nor irrigation had an obvious influence on this date of tagging in 1968. (See Figures 27 and 30 in the Appendix.) The slight decrease of mean NBS on date four could be attributed to the fewer NBT at that date in 1968. The trend for mean PBS in Figure 1 is more-or-less linear, showing a steady decrease throughout the flowering period. In 1970, there was a very noticeable drop of PBS on dates four and five; the reason appears to be that a comparatively high number of blooms were available for tagging on those dates that year, but that NBS did not increase correspondingly. The corollary to the steady decline in PBS through the season is that the rate of shedding increases steadily throughout the season since an inverse relationship exists between those two characteristics. This conclusion is in agreement with those of Buie (14) and Adcock (3). The mean performance of each variety over tagging dates and years for NBT, NBS, and PBS are shown in Figure 2. Westburn exhibited the highest NBT; but because of a high degree of shedding, its PBS was among the lowest of the varieties. Over all these experiments, Stoneville 7A had the second highest NBT and the highest NBS and PBS. Figure 3 shows the mean performance for NBT, NBS, and PBS over varieties and tagging dates in each of the three years. NBT and NBS were highest in 1969 and lowest in 1968. On the other hand, PBS was at a maximum in 1968 and 1969 and at a minimum in 1970.

For greater clarity in discussing the interactions observed, NBT, NBS, and PBS will be discussed separately on the following pages.

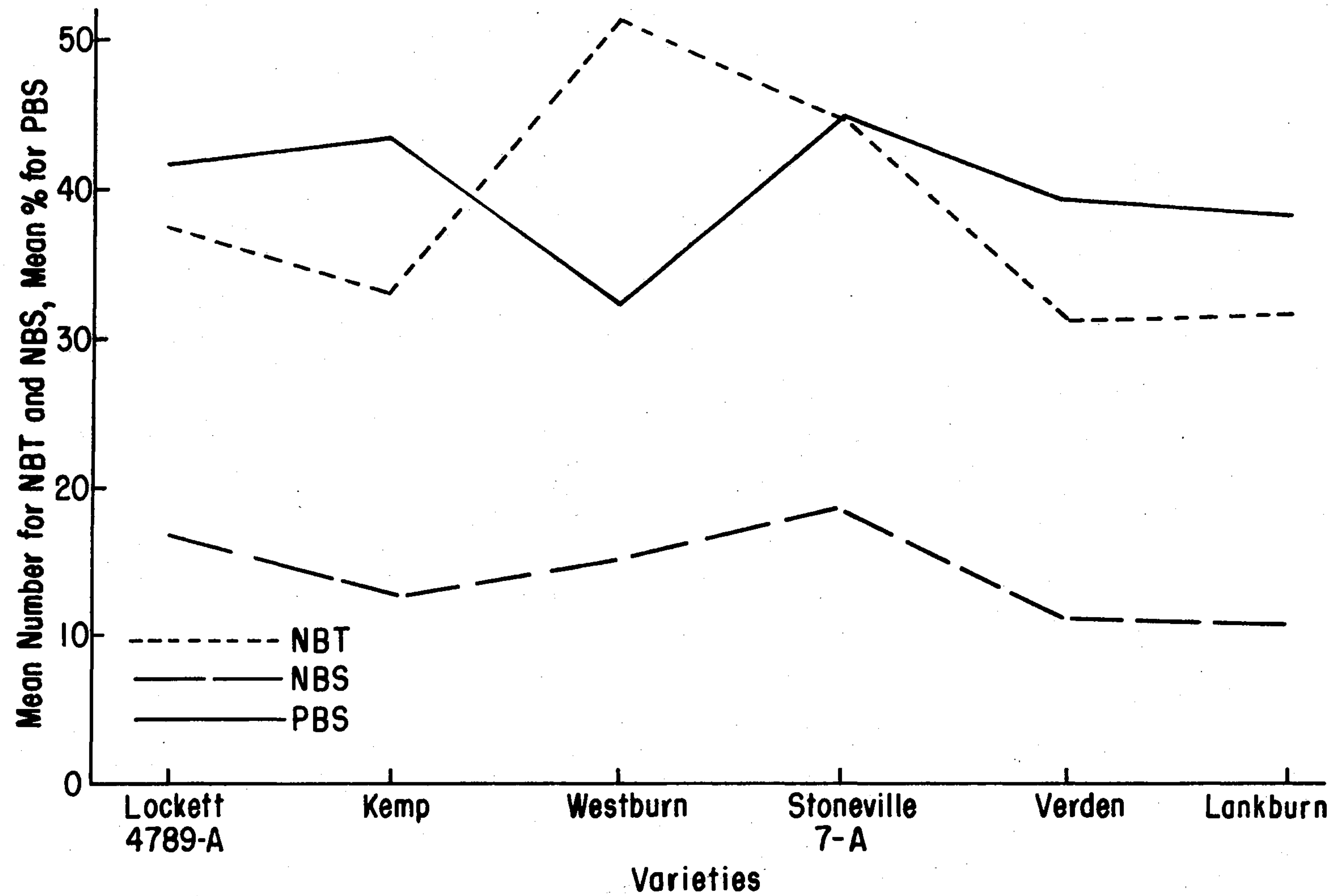

Figure 2. Mean Performance Over Tagging Dates and Years for NBT, NBS, and PBS by Varieties

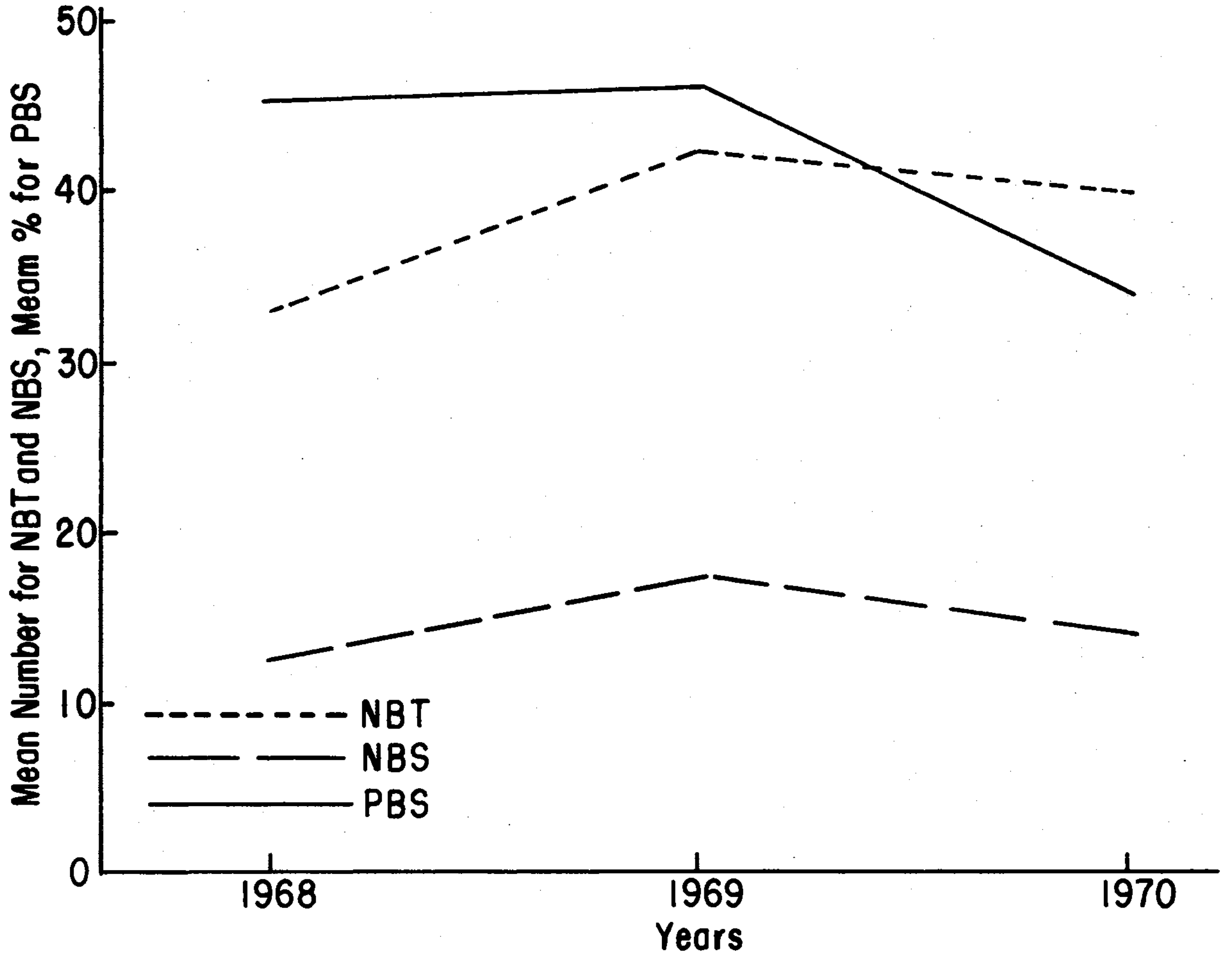

Figure 3. Mean Performance Over Tagging Dates and Varieties for NBT, NBS, and PBS by Years

NBT Interactions

The mean performance over varieties for NBT by tagging dates and years is presented in Figure 4. The decrease for date four in 1968 could not be attributed to maximum or minimum temperature nor to rainfall. The suspected cause for this decline was the irrigation made 10 to 14 days prior to this date. The irrigation did not have a visible effect on date three probably because the amount of time had been insufficient for the delayed effect to be operative. One gets the impression (from inspecting the graph) that number of blooms is a more-or-less symmetrical curve which is capable of being shifted as a whole to earlier or later in the year depending upon the onset of favorable environmental conditions for flowering. Westburn (Figure 5) exhibited the highest mean NBT over all tagging dates except the last. In 1969, (Figure 4) a temporary decrease occurred for all varieties on date five. The cause for this drop could be due to a rather pronounced decrease in maximum temperature which occurred a week earlier. Westburn in 1968 and 1969 (Figure 6) had the highest mean NBT over all tagging dates, but it switched places with Stoneville 7A in 1970. Lockett 4789-A (Figure 5) exhibited good performance for the first half of the blooming period while Stoneville 7A did for the second half. In general, Verden exhibited the least NBT particularly for the intermediate dates; while for the later dates in the season Lockett 4789-A had fewer blooms. The maximum NBT for all varieties, except Lockett 4789-A, occurred at date 5. A general inspection of Figure 4 shows that the flowering curve in 1970 started earlier than other two years; the mean temperatures in this year were higher and the peak temperatures

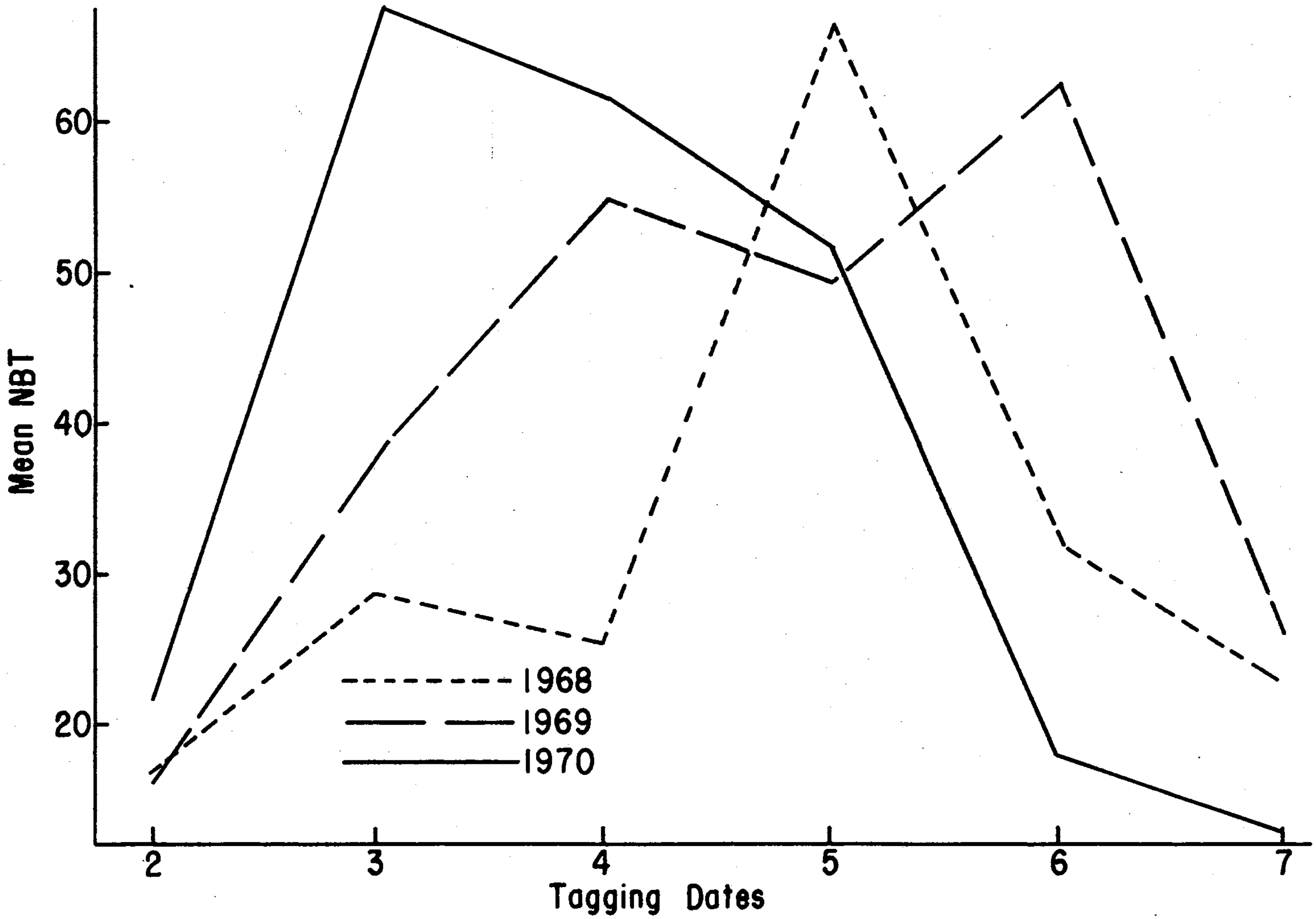

Figure 4. Mean Performance Over Varieties for NBT by Tagging Dates and Years

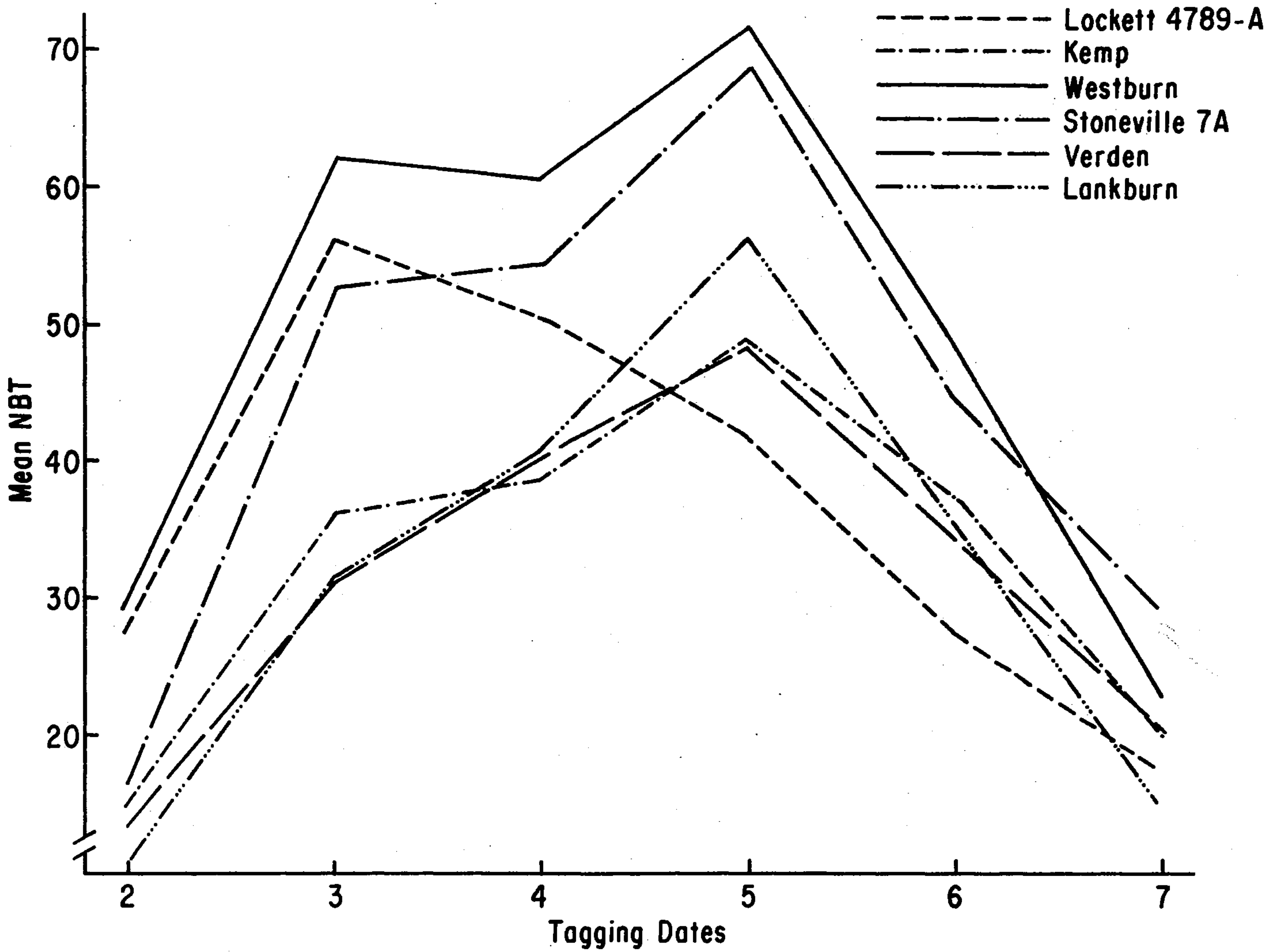

Figure 5. Mean Performance Over Years for NBT by Varieties and Tagging Dates

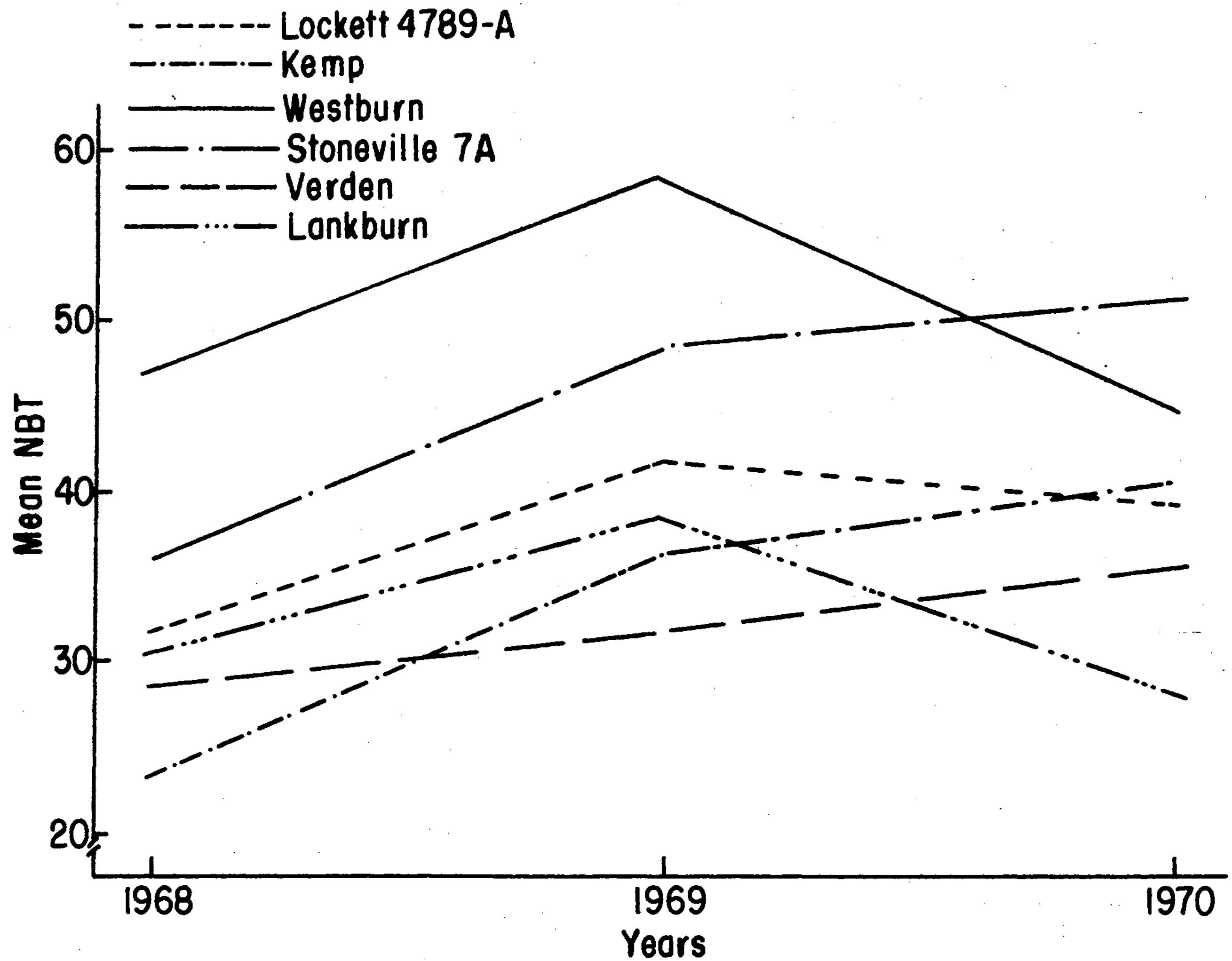

Figure 6. Mean Performance Over Tagging Dates for NBT by Years and Varieties

occurred between dates 2 and 5. In 1968 mean temperature was more constant and less as a whole than 1970. This low temperature is probably the reason for the delay in the occurrance of the peak NBT. The mean temperature in 1969 showed a drop several days before date five, and this was apparently effective in decreasing NBT on that date. Therefore, the mean temperature curve was in general agreement with the mean NBT curve. A 3- to 4-day delay between temperature fluctuation and NBT fluctuation appeared to be in effect.

Since the number of figures in this report are already quite numerous and since the many figures required to illustrate the significant second-order interaction for NBT would entail a great deal of duplication of material already presented, those figures have not been included herein. However, the data required to make those comparisons may be found in Table IV in the Appendix.

NBS Interactions

Figure 7 presents the mean number of tagged bolls (which matured one or more locks of seed cotton) produced over varieties at each tagging date each year.

In 1968 there was a drop in NBS on date 4. The reason for less boll set (expressed in absolute numbers) on that date could be a direct result of the fact that fewer bolls were tagged on that date. The curves for tagging dates in each year in Figure 7 for NBS look quite similar to those for NB~~S~~T in Figure 4, particularly in the first halves of their distributions. One of the main discrepancies between figures is a secondary peak for NB~~S~~T (Figure 4) in 1969 on tagging date six whereas that peak is not reflected at all in the corresponding

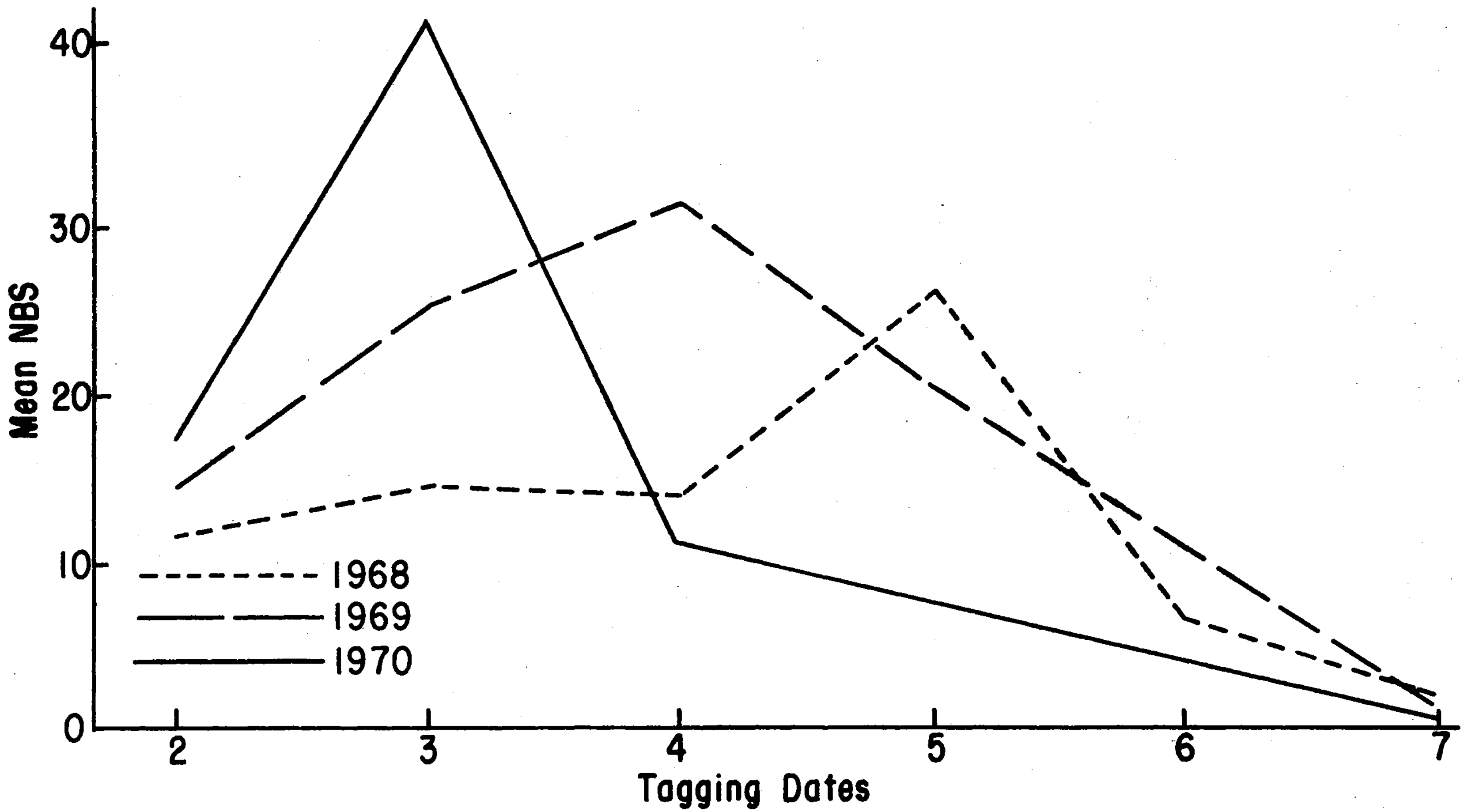

Figure 7. Mean Performance Over Varieties for NBS by Tagging Dates and Years

distribution for NBS (Figure 7). Figure 8 shows the mean performance over years for each variety at each tagging date. The peak tagging date for all varieties, except Verden, is at date three, early in the season. Lockett 4789-A, Westburn, and Stoneville 7A exhibited the highest performance for NBS for the first half of the blooming period; Lockett 4789-A and Westburn then rapidly declined while Stoneville 7A persisted at a high level, thereby setting considerably more bolls through the remainder of the season. Verden performed poorly for this trait particularly in the first half of the season.

Since the year X variety mean square for NBS was not significant (Table I), a figure exhibiting that data would be superfluous and was not included. Again, figures are not shown for the significant second-order interaction data; Table V in the Appendix includes that information.

<u>PBS Interactions</u>

Mean performance over varieties for PBS by tagging dates and year is given in Figure 9. The data exhibit a general trend toward a smaller and smaller percentage of the blooms being set as bolls as the season progresses. In 1968 on date four, a slight increase in PBS was evident. The increase is of interest because (as noted previously) this is the tagging date at which a reduction in NBT and NBS occurred. This increase therefore implies that the difference in observed NBS from the expected level of NBS (based on dates 3 and 5) was not entirely due to a lower NBT. Had this been true, the observed NBS would have been still lower. The increase in PBS implies that the plants were able to partially compensate for the scarcity of blooms by an

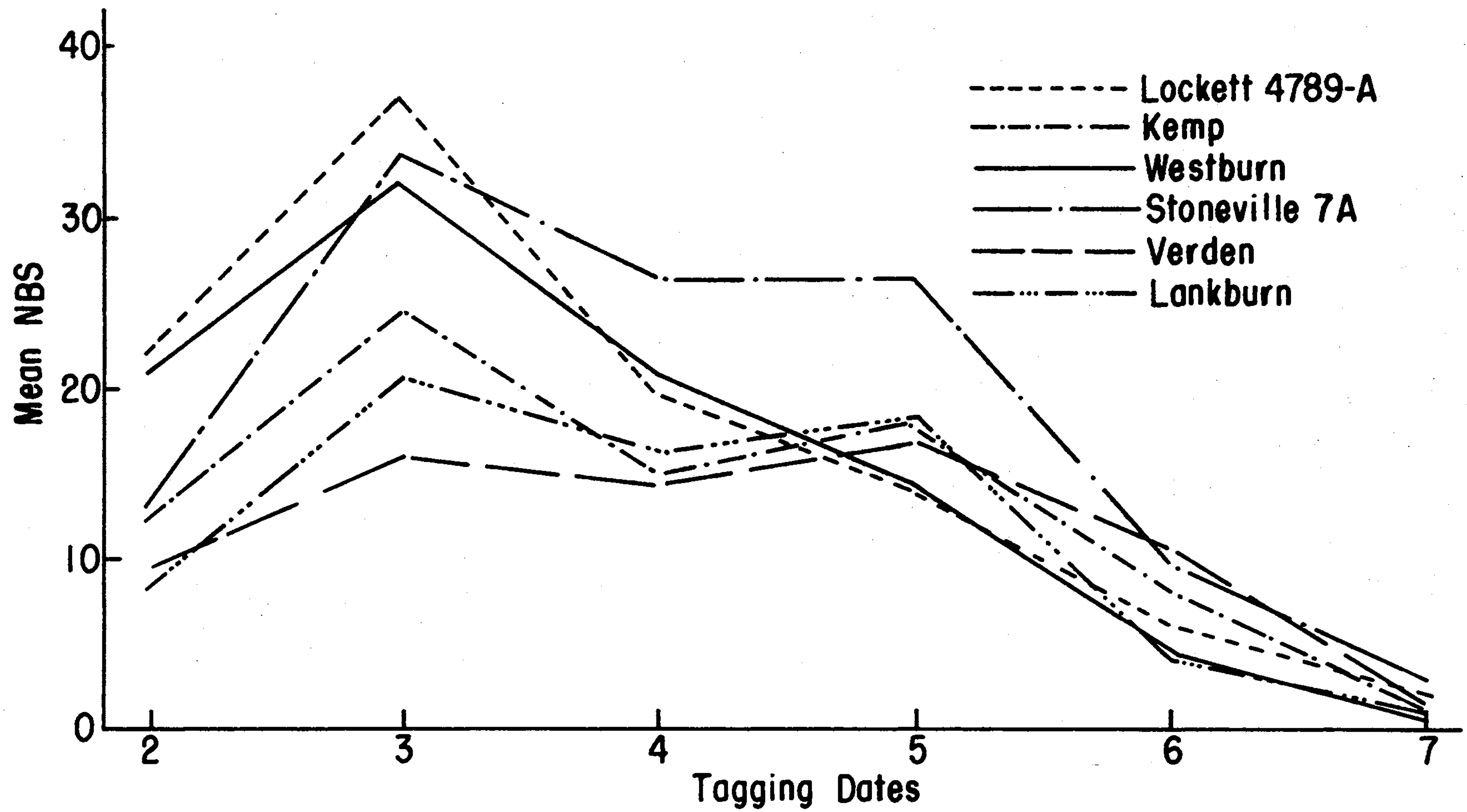

Figure 8. Mean Performance Over Years for NBS by Varieties and Tagging Dates

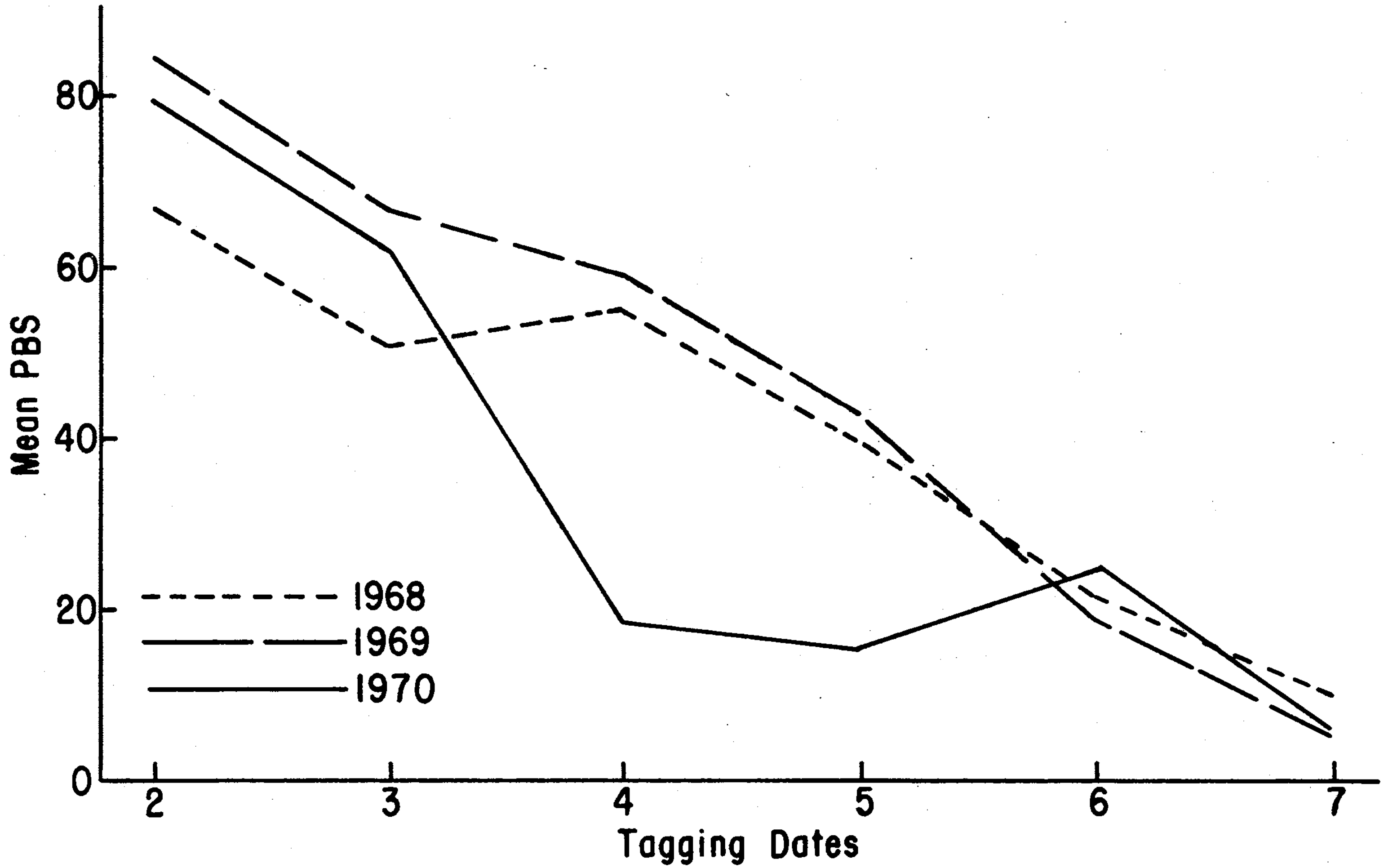

Figure 9. Mean Performance Over Varieties for PBS by Tagging Dates and Years

increase in the efficiency of retaining the ones they did have. The drastic drop in PBS on dates four and five in 1970 can probably be at least partially attributed to a period of high temperatures 7 to 10 days earlier in the season.

The mean performance over years for PBS by varieties and dates are given in Figure 10. As the season progressed, PBS decreased for all varieties. However, some varieties exhibited a more rapid decline than did others. Westburn particularly showed a rapid decrease in PBS. It was the variety lowest in PBS at all tagging dates except one. Stoneville 7A and Kemp performed well for this character with Lockett 4789-A coming in a strong third.

Since the year X variety mean square for PBS was not significant (Table I), a graph showing that two-way relationship (or lack of relationship) was not included herein. Figures are not provided for the significant three-factor interaction; Table VI in the Appendix includes that information.

Fiber Length Characters

Main Effects for 2.5% SL, 50% SL, and UNIF

In this section, the fiber properties 2.5% span length (2.5% SL), 50% span length (50% SL), and uniformity index (UNIF) are reported. Table II provides the analyses of variance for the three traits. All main effects were significant except the year mean square for 2.5% SL. All first-order interactions were significant except for the year X variety mean square for UNIF. The second-order interaction was significant for UNIF; whereas, it was not for 2.5% SL and 50% SL. In Figure

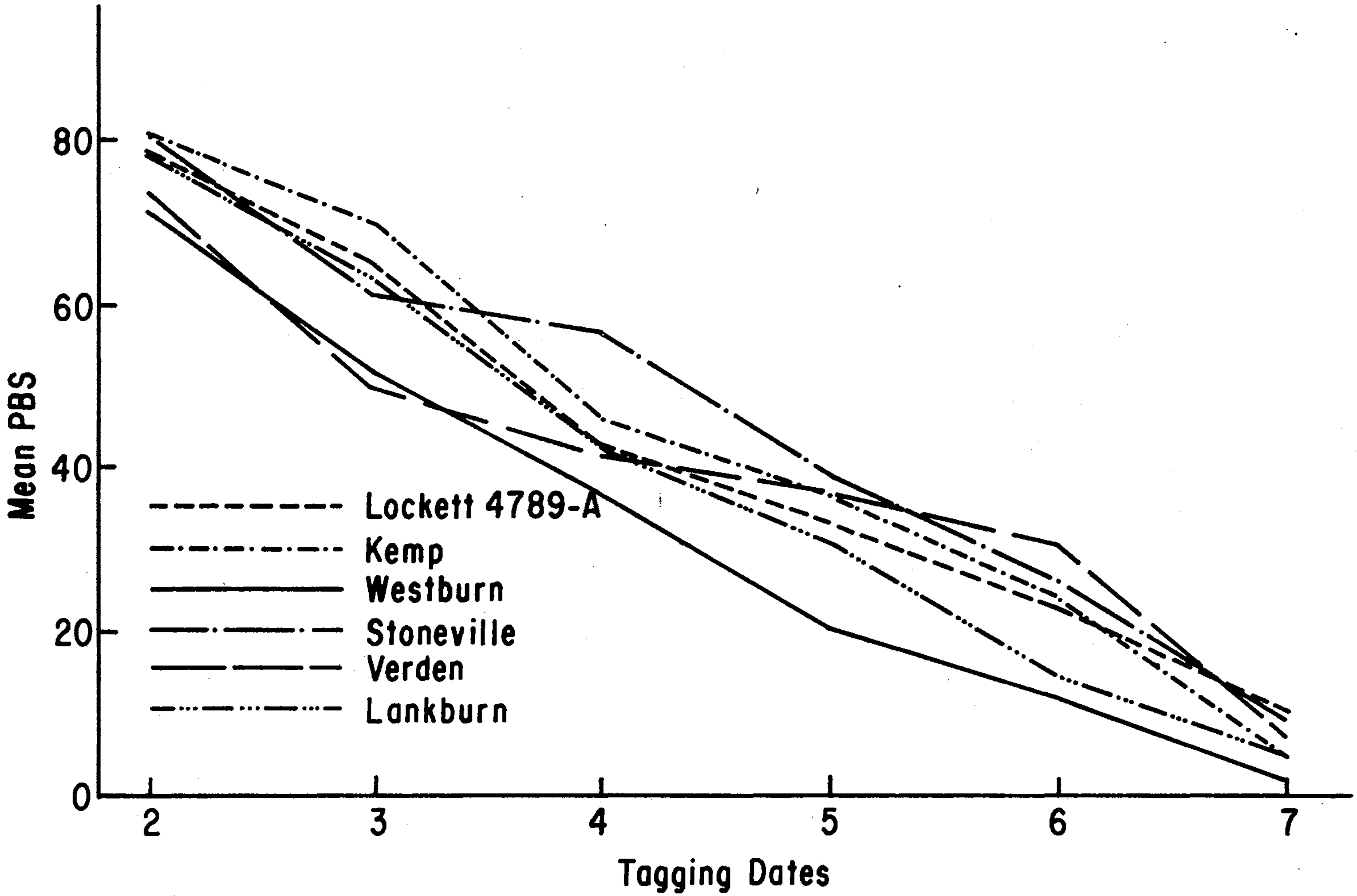

Figure 10. Mean Performance Over Years for PBS by Varieties and Tagging Dates

TABLE II

ANALYSES OF VARIANCE FOR 2.5% SL, 50% SL, AND UNIF

Source	df	Mean Squares		
		2.5% SL	50% SL	UNIF
Year	2	0.023885	0.027161*	89.02**
Rep (Year)	3	0.004320	0.001206	0.74
Variety	5	0.046276**	0.007770**	92.84**
Year X Variety	10	0.002052*	0.000874*	2.00
Rep X Variety (Year)	15	0.000721	0.000252	1.37
Date	4	0.066448**	0.011762**	7.49**
Year X Date	8	0.018368**	0.002859**	27.24**
Rep X Date (Year)	12	0.000674	0.000291	1.38
Variety X Date	20	0.000649**	0.000201*	0.95*
Year X Variety X Date	40	0.000275	0.000138	0.91*
Rep X Variety X Date (year)	60	0.000225	0.000095	0.48
Corrected Total	179	0.004368	0.001106	5.77

*,** Significant at the 0.05 and 0.01 levels of probability, respectively.

11, 2.5% SL and 50% SL exhibited more-or-less steady decreases as the flowering season progressed. In contrast, UNIF exhibited a distribution with minimum values at the middle of the flowering season and higher readings at the beginning and end. Date six (the last studied) produced the most uniform fibers. Apparently, the normally longer fibers are reduced in length to a greater extent than are the usually shorter ones. Figure 12 presents the mean response over tagging dates and years for each variety for 2.5% SL, 50% SL, and UNIF. Stoneville 7A and Lankburn displayed the highest 2.5% SL. Differences for 50% SL were not pronounced, but Westburn did have the shortest 50% SL. Kemp and Verden had the highest UNIF. Since Kemp had the shortest 2.5% SL, the reason for its high UNIF is not too different to determine. Verden had the highest 50% SL, about average 2.5% SL, and the highest UNIF over dates and years. Figure 13 provides the mean performance of 2.5% SL, 50% SL, and UNIF for each year. The differences between years for 2.5% SL were not significant (Table II); and discussion of them would be unjustified by the evidence available. 50% SL displayed its maximum performance in 1969, but here again the differences were small. The ratio of 50% SL/2.5% SL, i.e., UNIF, was at its maximum value in 1968 and 1969.

2.5% SL Interactions

The mean response over varieties for 2.5% SL by tagging dates in each year is presented in Figure 14. In 1968, there is a decline on date three, a rise on date four, and a subsequent decline through the remainder of the season. In 1969, there was an increase through date four, then a decline. In 1970, there was an increase at date three

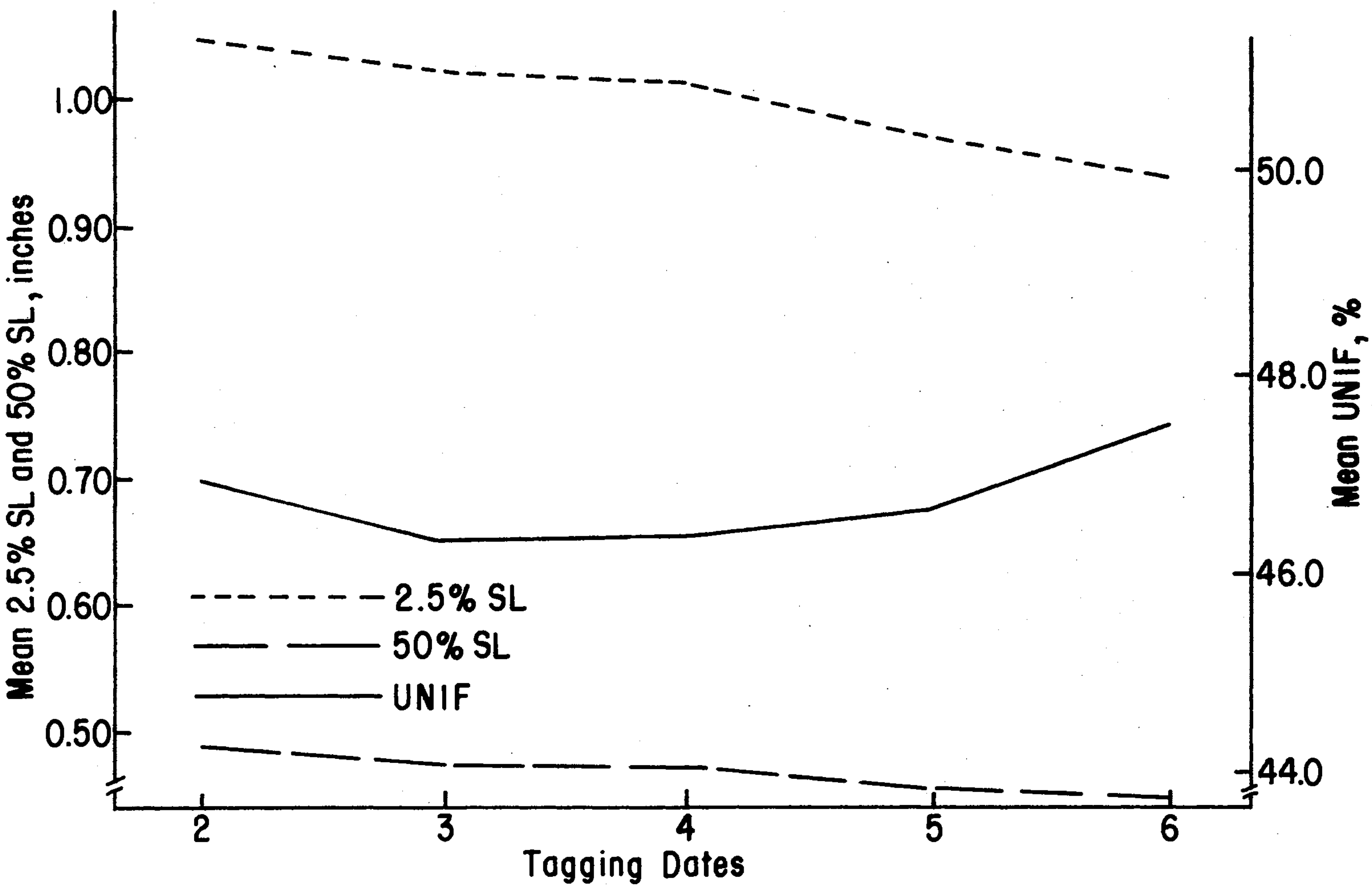

Figure 11. Mean Performance Over Varieties and Years for 2.5% SL, 50% SL, and UNIF by Tagging Dates

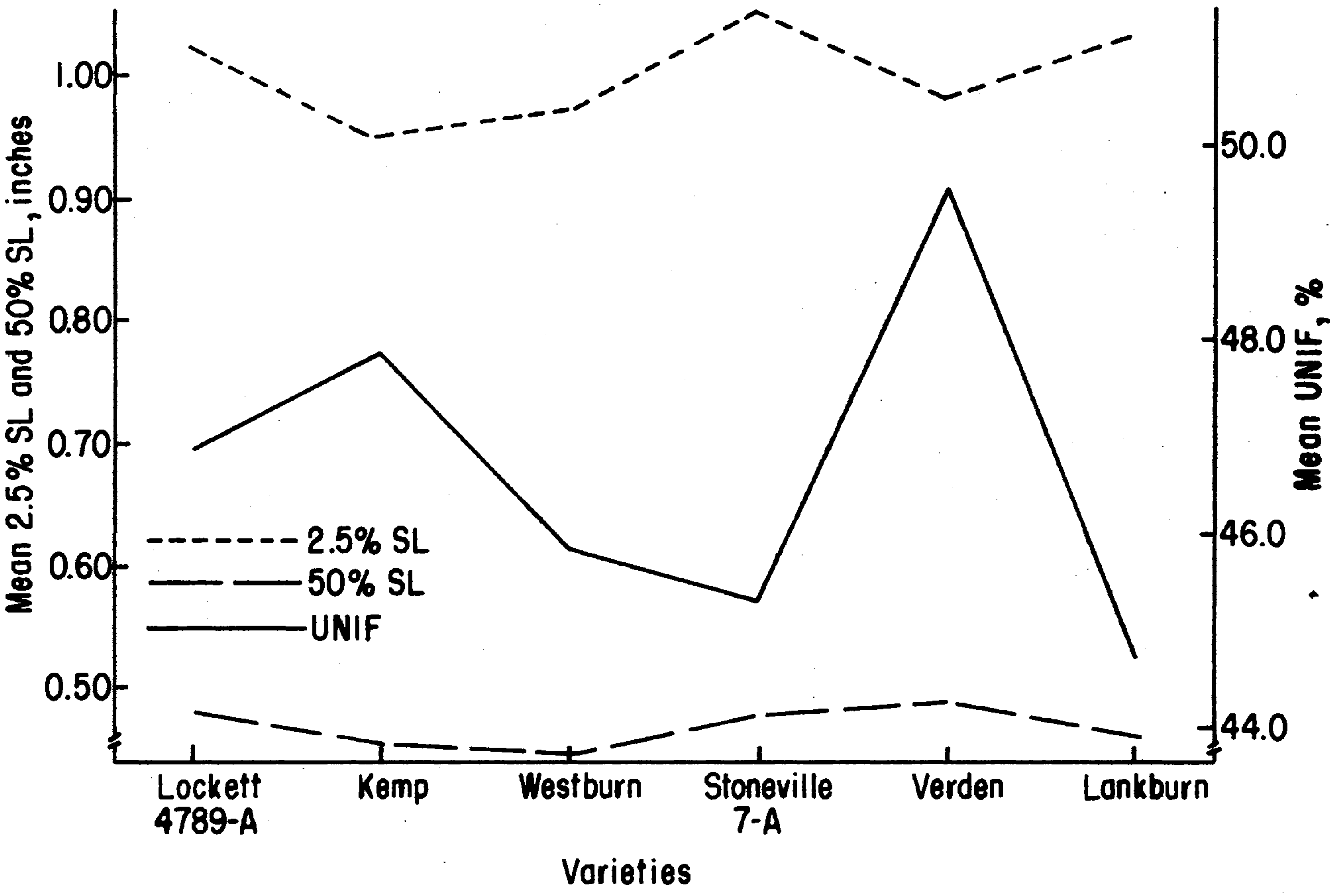

Figure 12. Mean Performance Over Tagging Dates and Years for 2.5% SL, 50% SL, and UNIF by Varieties

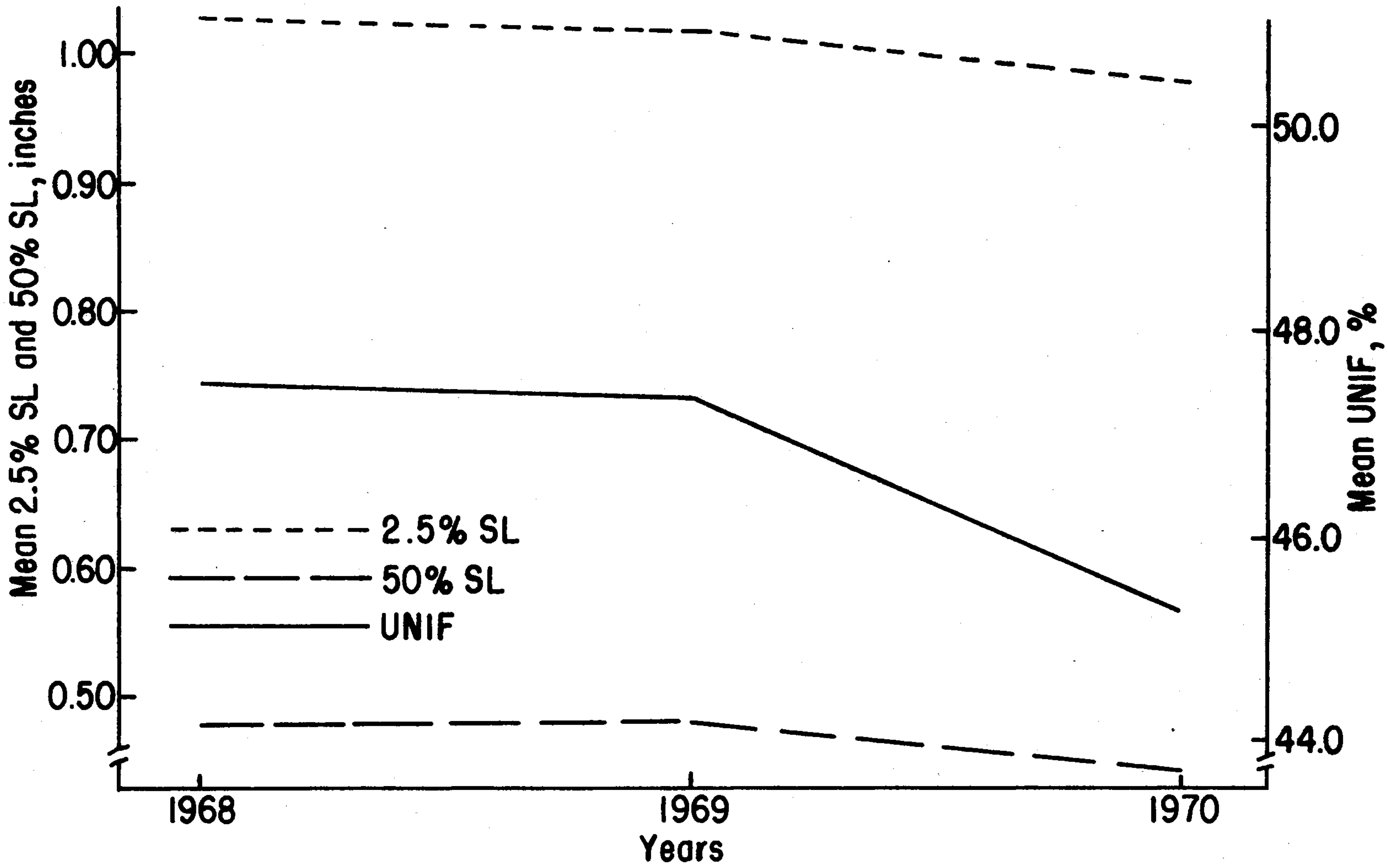

Figure 13. Mean Performance Over Tagging Dates and Varieties for 2.5% SL, 50% SL, and UNIF by Years

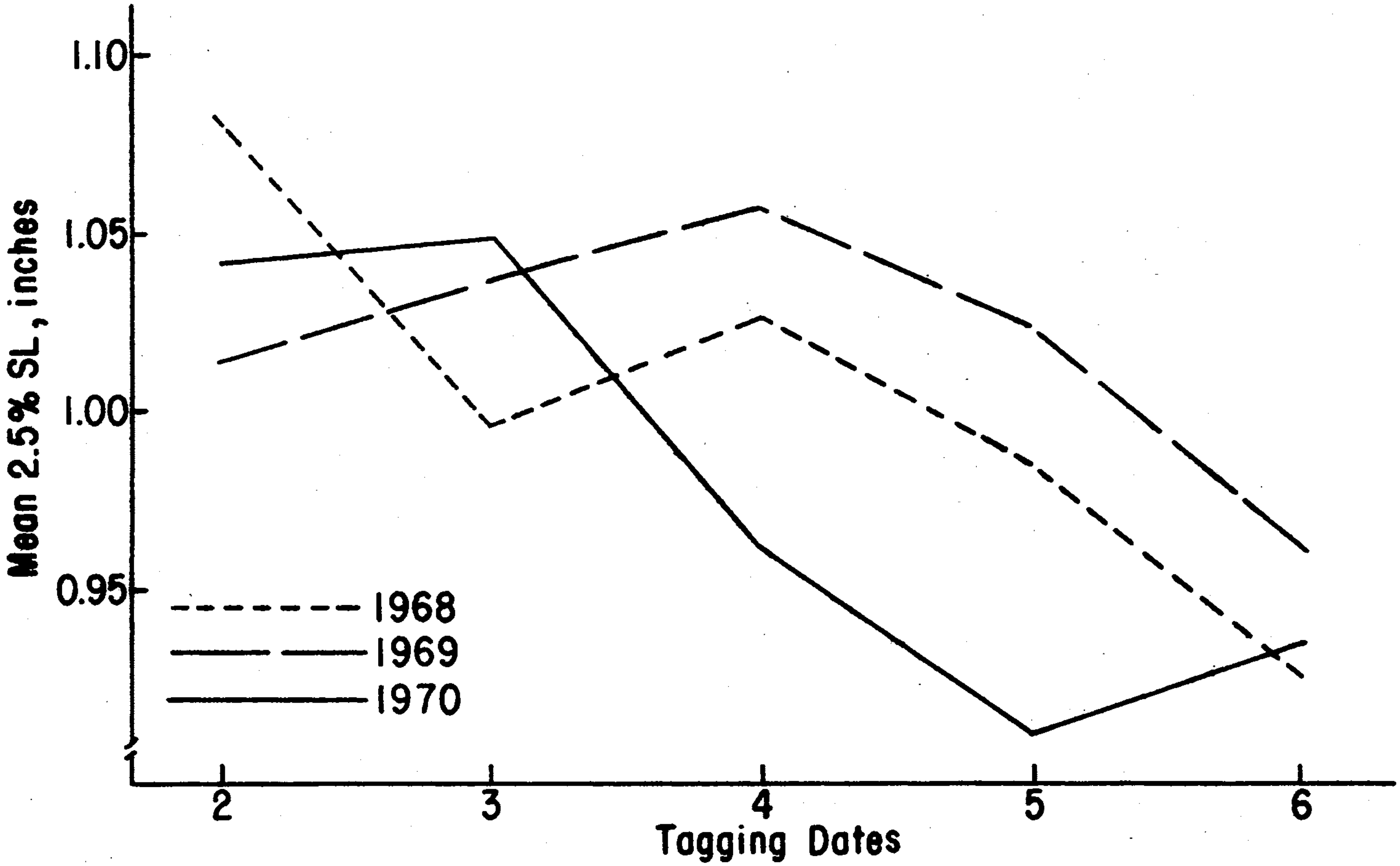

Figure 14. Mean Performance Over Varieties for 2.5% SL by Tagging Dates and Years

followed by a constant decline except at date six where an increase was detected which may or may not be significant. The three years exhibited considerably different patterns for this character. The general decrease of 2.5% SL as the latter part of the season progressed is in agreement with most previous reports (9, 12, 25, 39, 47, 49).

Figure 15 shows the mean response over years of 2.5% SL for each variety by tagging dates. It is obvious that Stoneville 7A had the longest 2.5% SL over the season while Kemp had the lowest. The 2.5% SL's for Lockett 4789-A and Lankburn were quite similar, but lower than Stoneville 7A. Verden exhibited a longer 2.5% SL than did Westburn which in turn was greater than Kemp. All varieties showed a more-or-less steady decrease through the season for this trait.

Figure 16 illustrates the response over tagging dates of the six varieties in each of the three years. Conclusions as to relative varietal performance correspond to those made from Figure 15. Except for Kemp, varietal performance for this trait was highest in 1969. Although the second-order interaction for this trait was not significant, it was decided to retain the data as a permanent record in Table VII in the Appendix.

50% SL Interactions

The mean response over varieties for 50% SL by years and dates is given in Figure 17. The distribution for 50% SL in 1968 follows the same pattern as did that for 2.5% SL in the same year (Figure 14). This is not totally unexpected since the factor or factors which influence fiber elongation should have at least a similar effect on all fiber length characteristics. In 1969, the patterns are also similar.

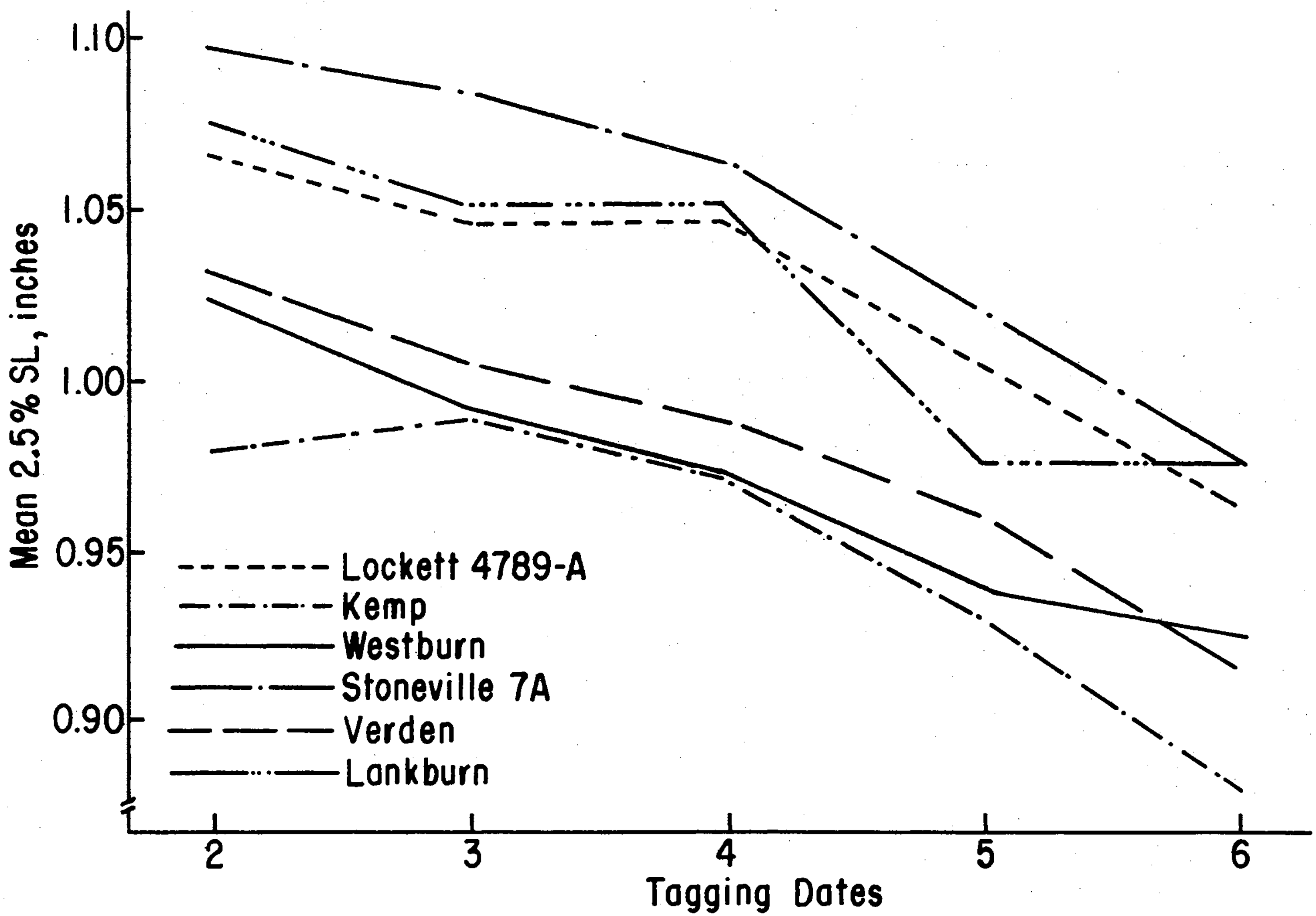

Figure 15. Mean Performance Over Years for 2.5% SL by Varieties and Tagging Dates

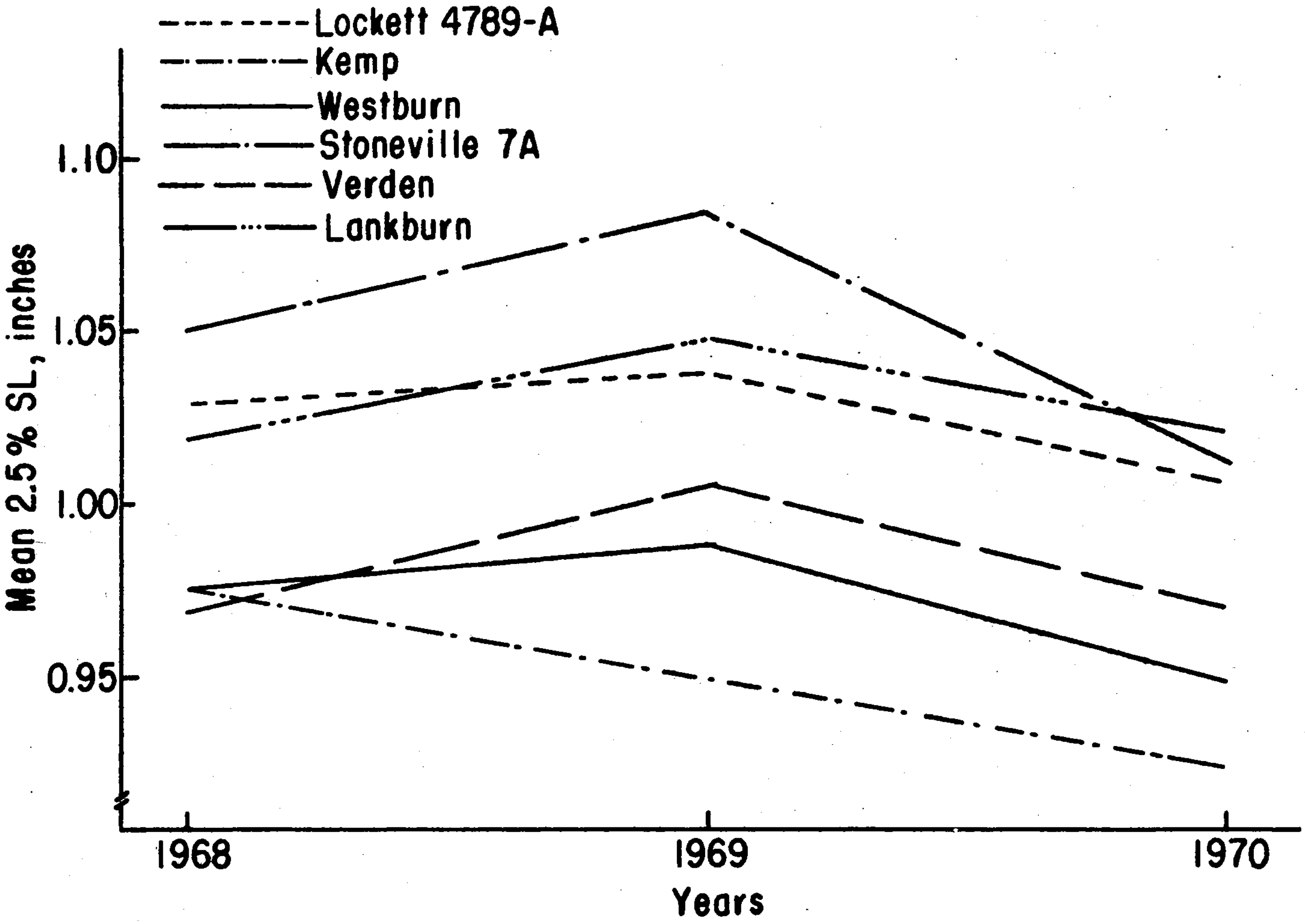

Figure 16. Mean Performance Over Tagging Dates for 2.5% SL by Years and Varieties

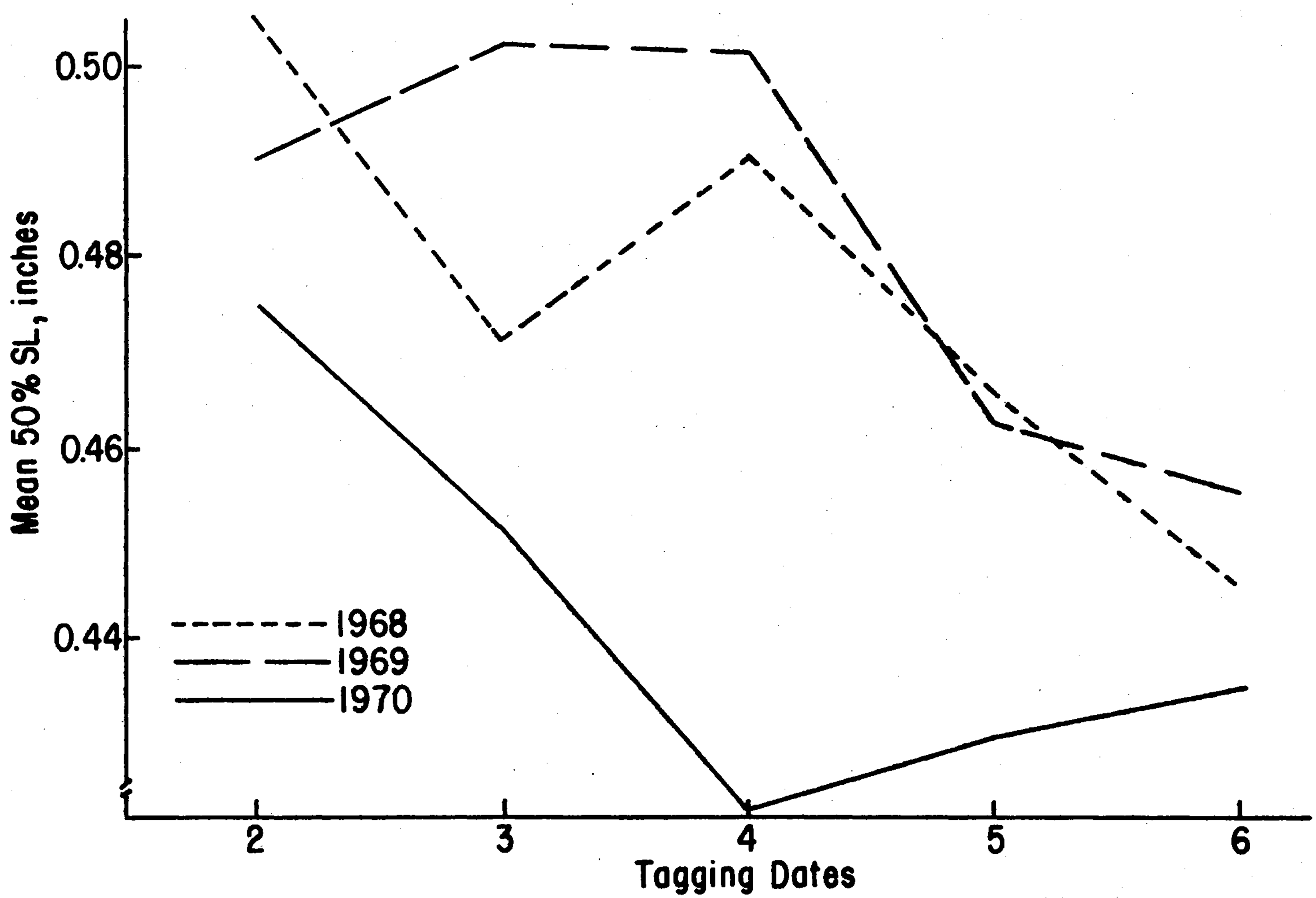

Figure 17. Mean Performance Over Varieties for 50% SL by Tagging Dates and Years

The date of maximum length for 50% is on date four. The drop in length on date five appears to be more rapid than that for 2.5% SL in the same year; but in general, their patterns were not a great deal different. The 1970 distribution did not increase in date three as it did for 2.5% SL (Figure 14); it decreased steadily through date four and then increased on dates five and six. 2.5% SL had exhibited an increase only on date six. The pattern for 50% SL in 1970 for dates two through five was similar to the pattern for 2.5% SL in 1970 for dates three through six. This could be interpreted in that year as a week's delay to obtain a response in the longer fibers comparable to that in the shorter fibers.

Figure 18 presents the mean performance over years for 50% SL for each variety and tagging date. Verden displayed the highest 50% SL over all dates while Westburn was in general the lowest. Lockett 4789-A was the second highest while Stoneville 7A (the variety with the highest 2.5% SL) came in third. Stoneville 7A and Lankburn exhibited more pronounced interactions between tagging dates than did the other varieties tested.

In Figure 19, mean 50% SL over tagging dates for each variety in each year can be seen. Except for Kemp and Westburn, 1969 was the year which allowed maximum expression of 50% SL while 1970 (for all varieties) allowed the least. Even though the second-order interaction was not significant for 50% SL, that data is included in Table VIII in the Appendix as a record of the mean values obtained.

UNIF Interactions

Mean performance over varieties for UNIF by tagging dates and

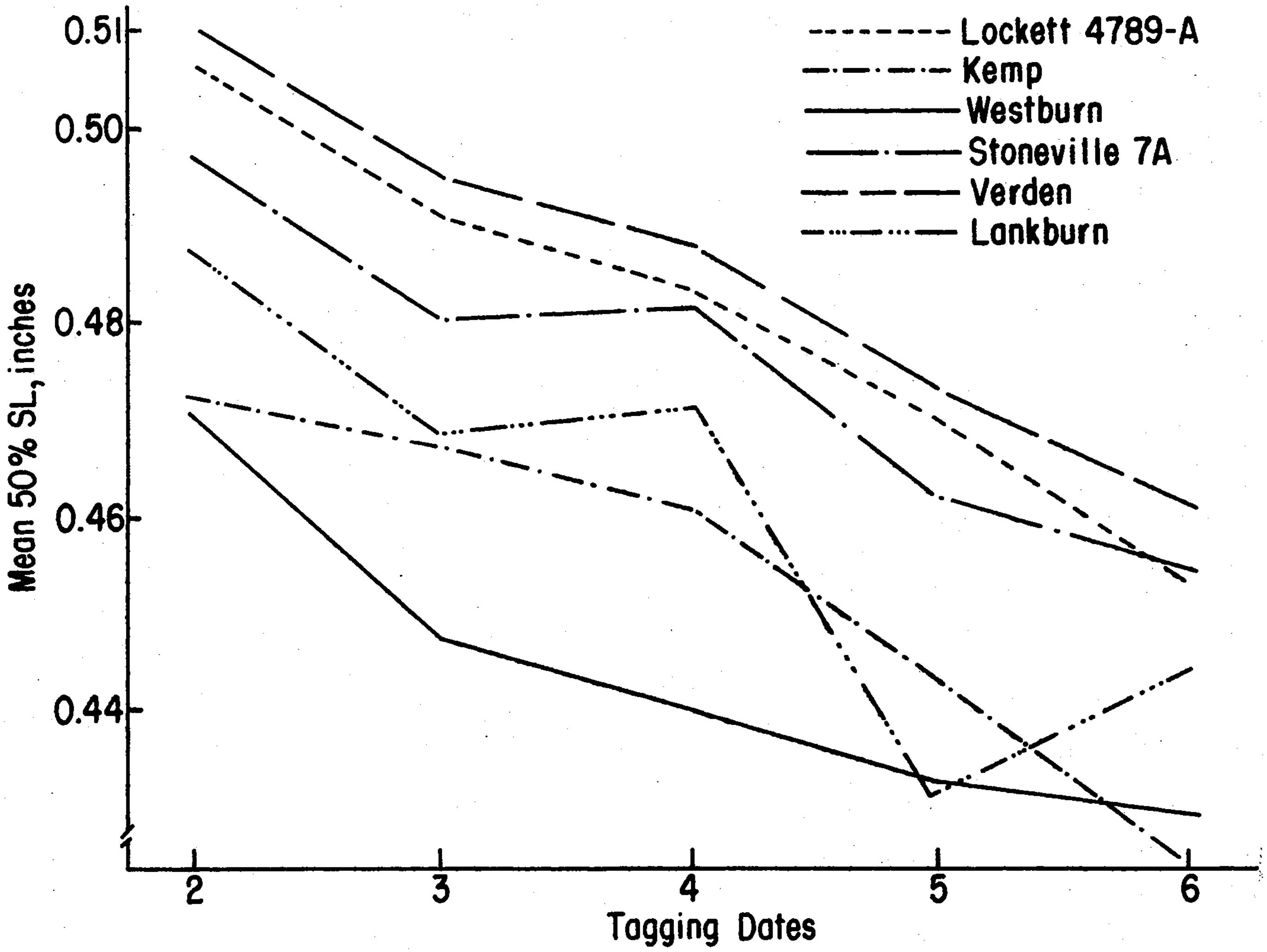

Figure 18. Mean Performance Over Years for 50% SL by Varieties and Tagging Dates

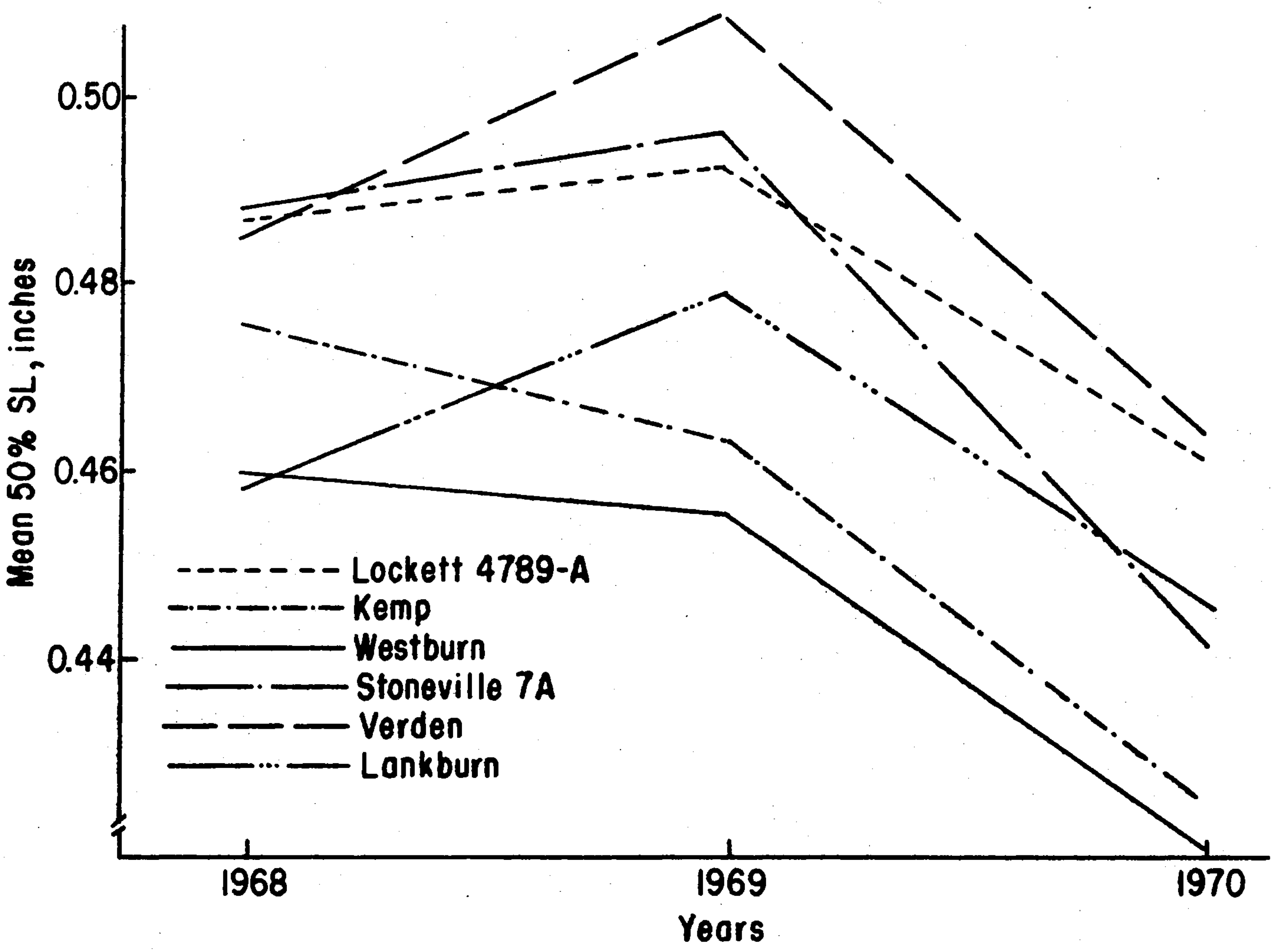

Figure 19. Mean Performance Over Tagging Dates for 50% SL by Years and Varieties

years is presented in Figure 20. Except for a slight deviation on date five, the 1968 distribution shows a gradual increase from dates two through six. In the other years, concave-type curves were in evidence. Although the patterns between years were so different, apparently one can state that more uniform fibers were produced at the end of the flowering period than through the middle. In two of the three years, more uniform fiber was also produced at the first of the season than through mid-season.

The mean UNIF response over years for each variety on each tagging date is presented in Figure 21. All varieties demonstrated a mean increase in UNIF at the last tagging dates in the season over the intermediate dates. Some varieties had higher UNIF at the start of the season than at some of the intermediate tagging dates. Among the varieties in question, Verden had the most uniform fibers followed in order by Kemp, Lockett 4789-A, and Westburn. Lankburn and Stoneville 7A were very similar for UNIF at dates two, three, and four, but were approximately quite different at dates five and six.

Since the year X variety mean square for UNIF was not significant (Table II), a figure showing such observations is unnecessary and could possibly be misleading. Therefore, it was not included. The second-order interaction was significant for this trait, and that data is provided in Table IX in the Appendix.

Fiber Strength

All sources of variation for fiber strength (T_1) were significant except for the year X variety mean square (Table III). In Figure 22, the mean performances over varieties for fiber strength (T_1) for each

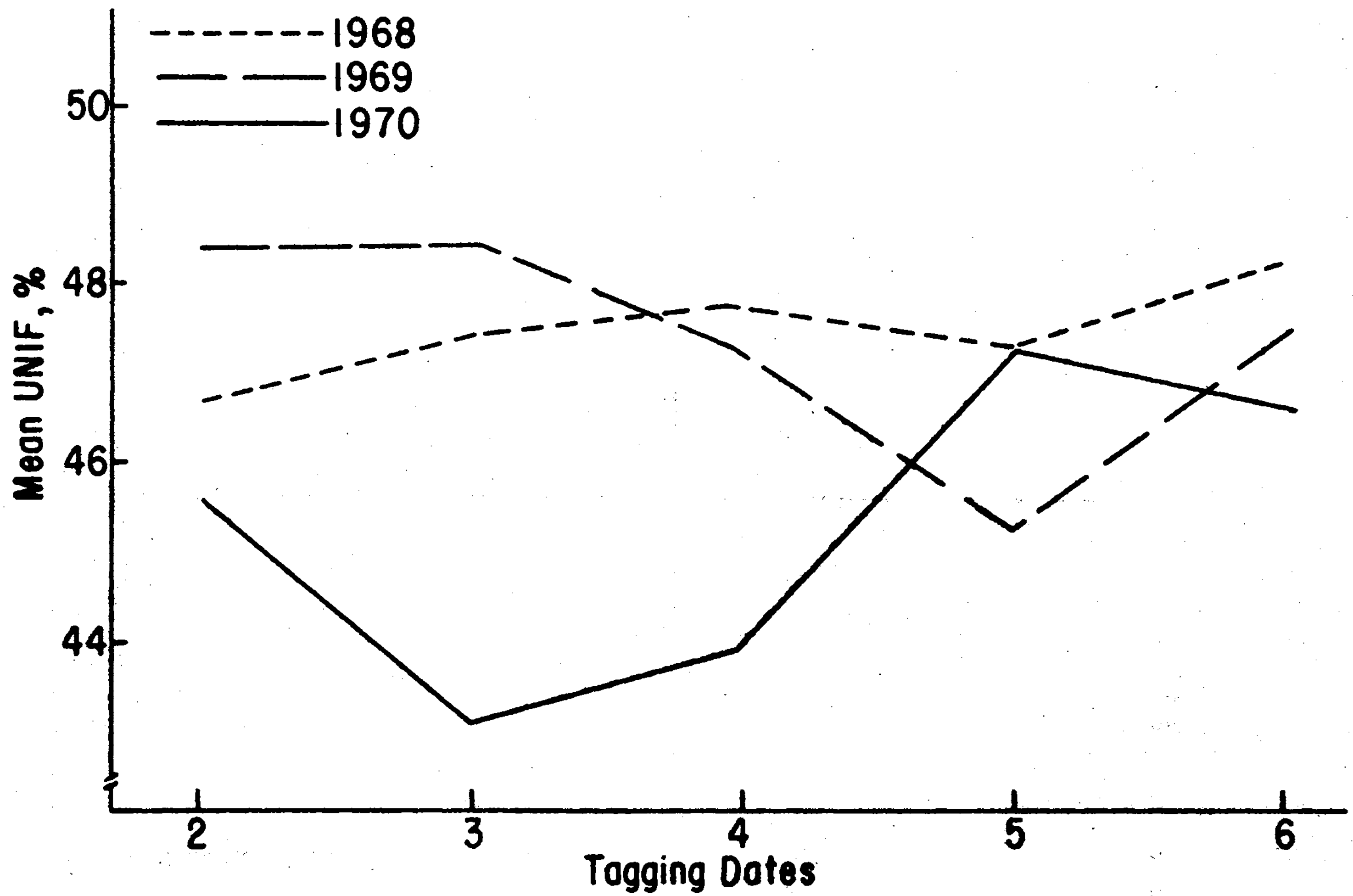

Figure 20. Mean Performance Over Varieties for UNIF by Tagging Dates and Years

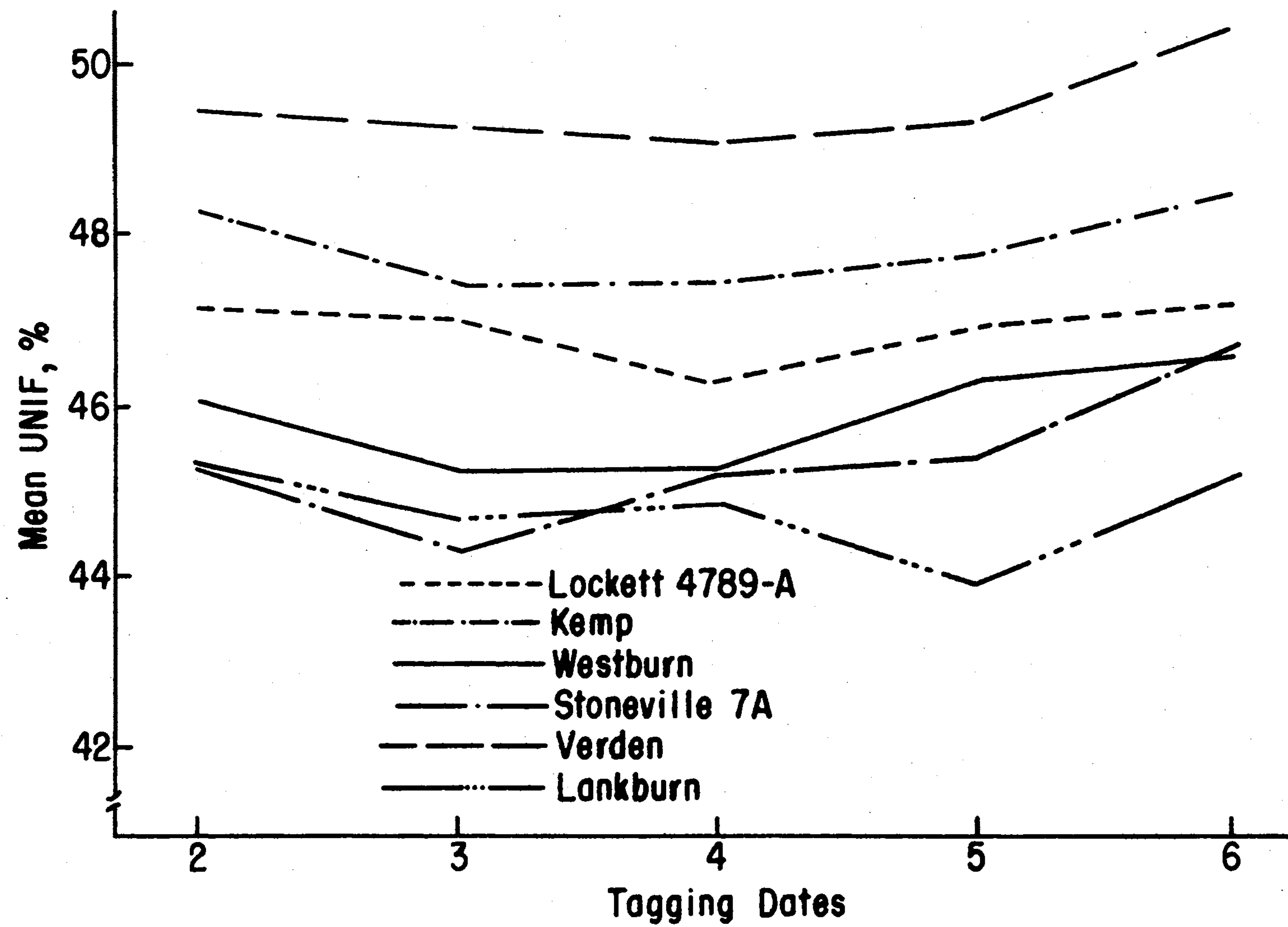

Figure 21. Mean Performance Over Years for UNIF by Varieties and Tagging Dates

TABLE III

ANALYSES OF VARIANCE FOR T_1 AND MIC

Source	df	Mean Squares T_1	MIC
Year	2	0.6707*	0.2882
Rep (Year)	3	0.0328	0.1369
Variety	5	0.2338**	2.8337**
Year X Variety	10	0.0281	0.2374**
Rep X Variety (Year)	15	0.0195	0.0555
Date	4	0.1500**	0.6871**
Year X Date	8	0.0490**	2.1308**
Rep X Date (Year)	12	0.0047	0.0407
Variety X Date	20	0.0109**	0.1690**
Year X Variety X Date	40	0.0058**	0.1077**
Rep X Variety X Date (Year)	60	0.0026	0.0496
Corrected Total	179	0.0270	0.2755

*,** Significant at the 0.05 and 0.01 level of probability, respectively

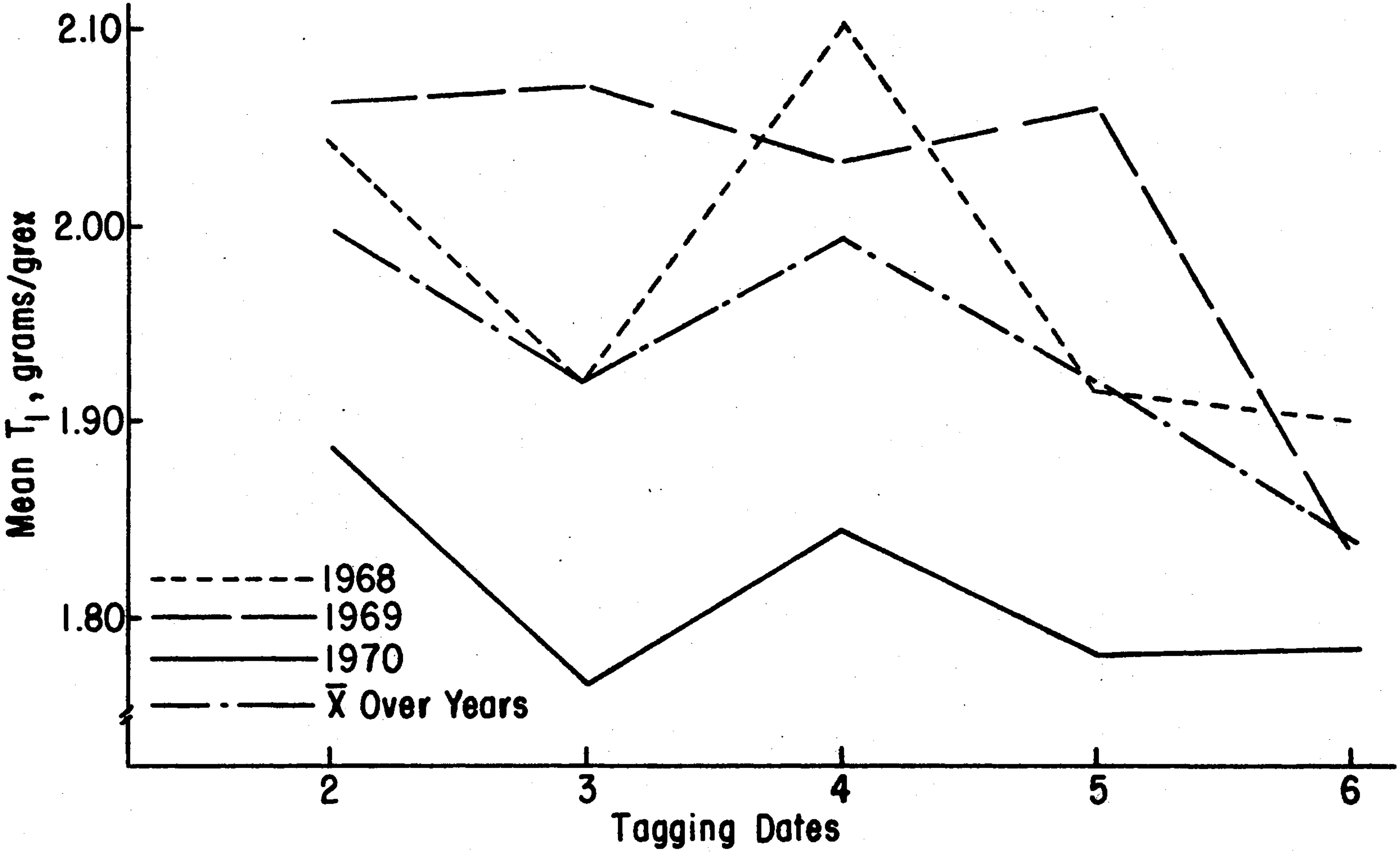

Figure 22. Mean Performance Over Varieties for T_1 by Tagging Dates and Years

year and over years can be observed at each tagging date. In general, the mean over varieties and years indicates that fiber strength decreases fairly progressively the later in the season that a bloom develops. In 1968 and 1970, the distributions for T_1 were similar whereas the one in 1969 was considerably different.

The mean performance over years for T_1 by varieties and tagging dates is shown in Figure 23. All varieties exhibited an overall decrease on date three and/or an increase on date four. After this date, the varietal performance for T_1 decreased except in two cases. In general, all the varieties showed a general decline in fiber strength toward the end of the flowering period. Lockett 4789-A had the highest fiber strength while Kemp had the weakest. Westburn and Verden were in a position slightly below Lockett 4789-A while Stoneville 7A and Lankburn were intermediate between Westburn-Verden and Kemp.

Since the year X variety mean square for T_1 was not significant (Table III), a figure showing that data was not included. The data related to the significant second-order interaction for this character are shown in Table X in the Appendix.

Fiber Fineness

All sources of variation, except the year mean square, were significant for MIC (Table III). In Figure 24, the mean performances over varieties for MIC by tagging dates and years are exhibited. The difference in mean performance between years was not significant (Table III). However, the interaction between years and tagging dates was highly significant. This is well illustrated by the strikingly different distribution patterns exhibited between years for tagging date

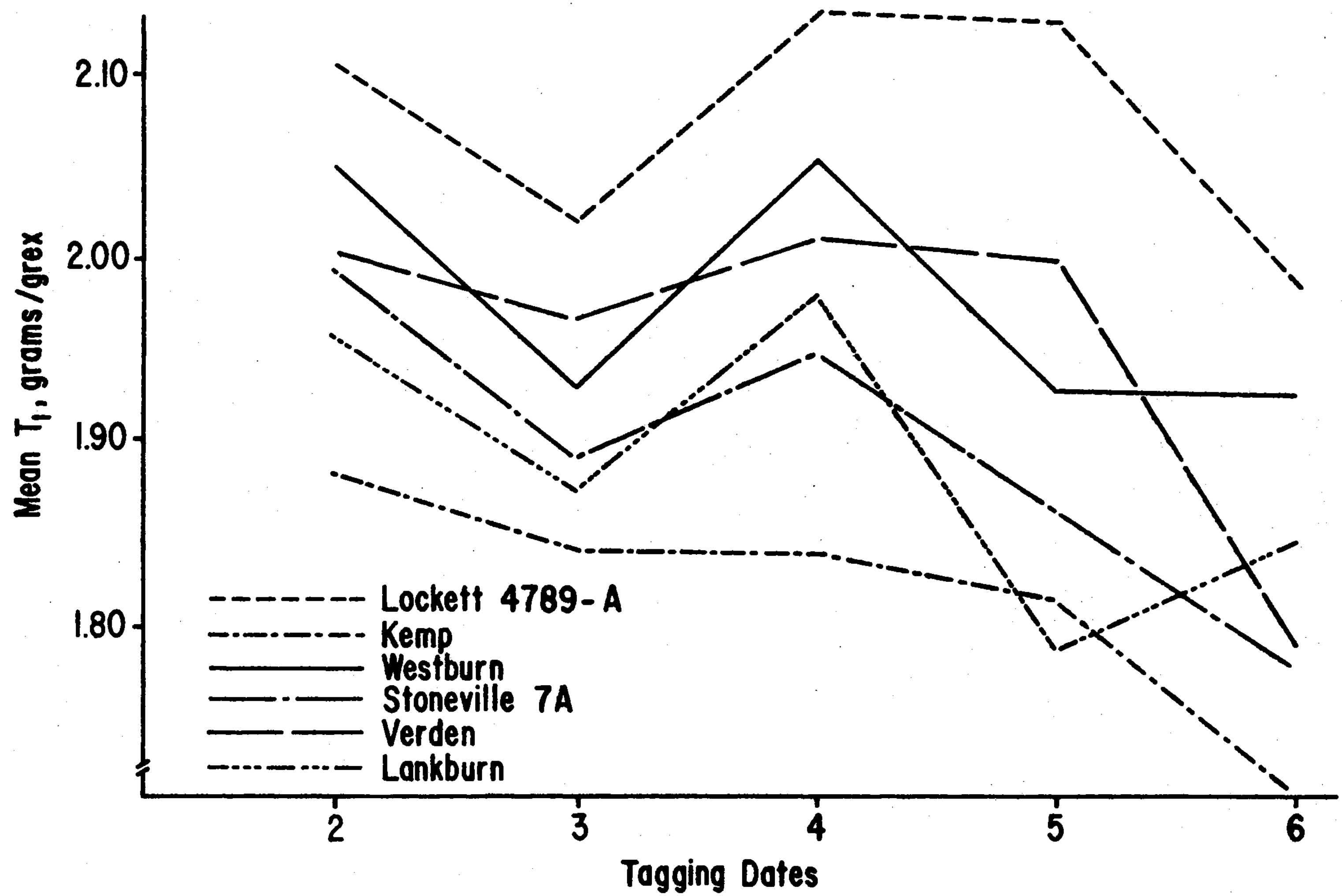

Figure 23. Mean Performance Over Years for T_1 by Varieties and Tagging Dates

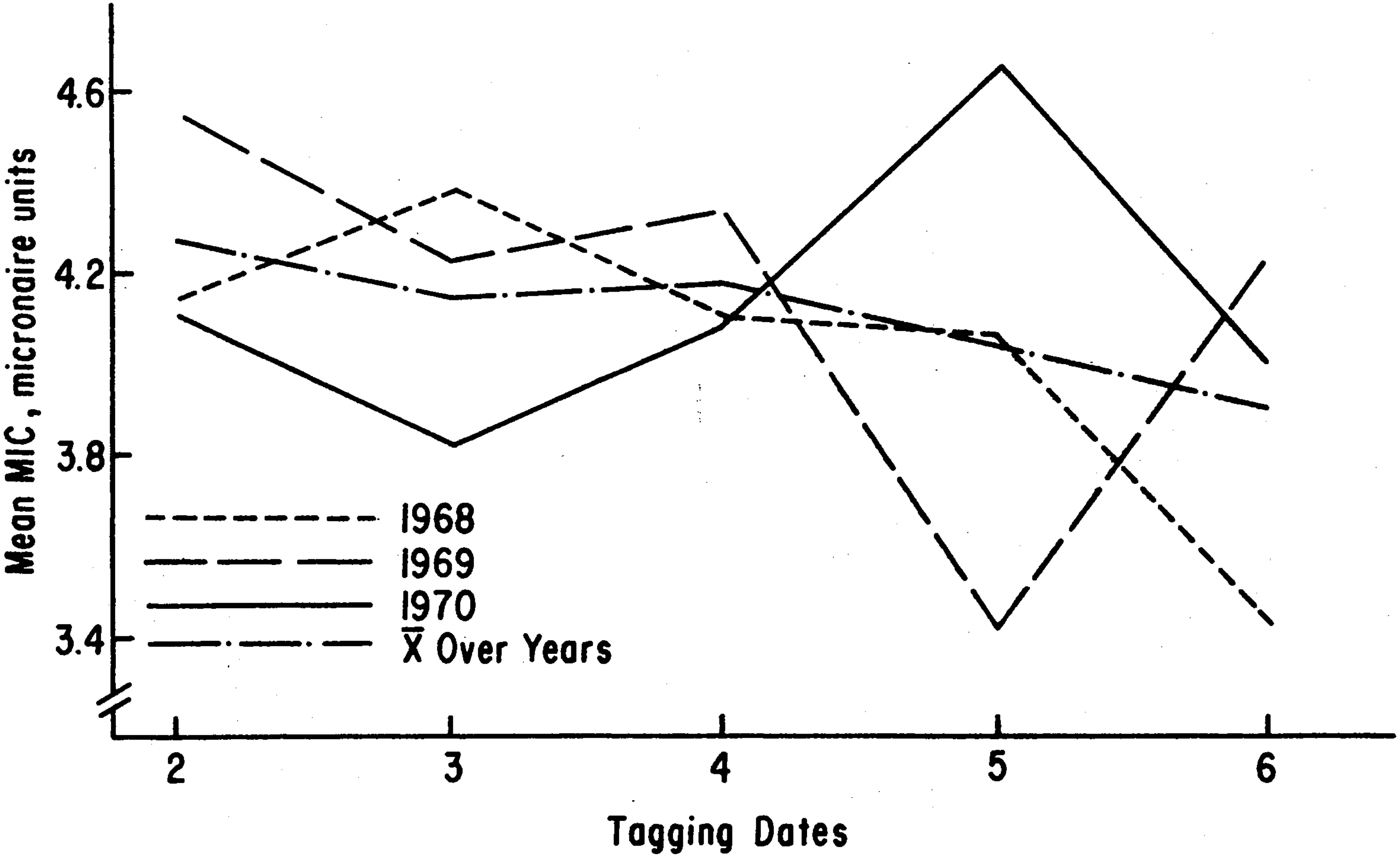

Figure 24. Mean Performance Over Varieties for MIC by Tagging Dates and Years

in Figure 24. Seemingly, the reasons for the sudden decrease on date five in 1969 and increase on the same date in 1970 were a severe drop of maximum temperature in 1969 and a considerable increase in 1970 some 7 to 10 days before this date.

Figure 25 shows the mean performances over years for MIC by varieties and tagging dates. Westburn has by far the finest fibers while Verden has the coarsest. Except for Verden, MIC was lower for each of the varieties at the end of the season than it was at the first.

The mean performance over tagging dates for MIC by years and varieties is presented in Figure 26. Inferences as to varieties from this figure are the same as from Figure 25. Considerable interactions among varieties and years are evident. The data in regard to the significant three-factor interaction for this trait are given in Table XI in the Appendix.

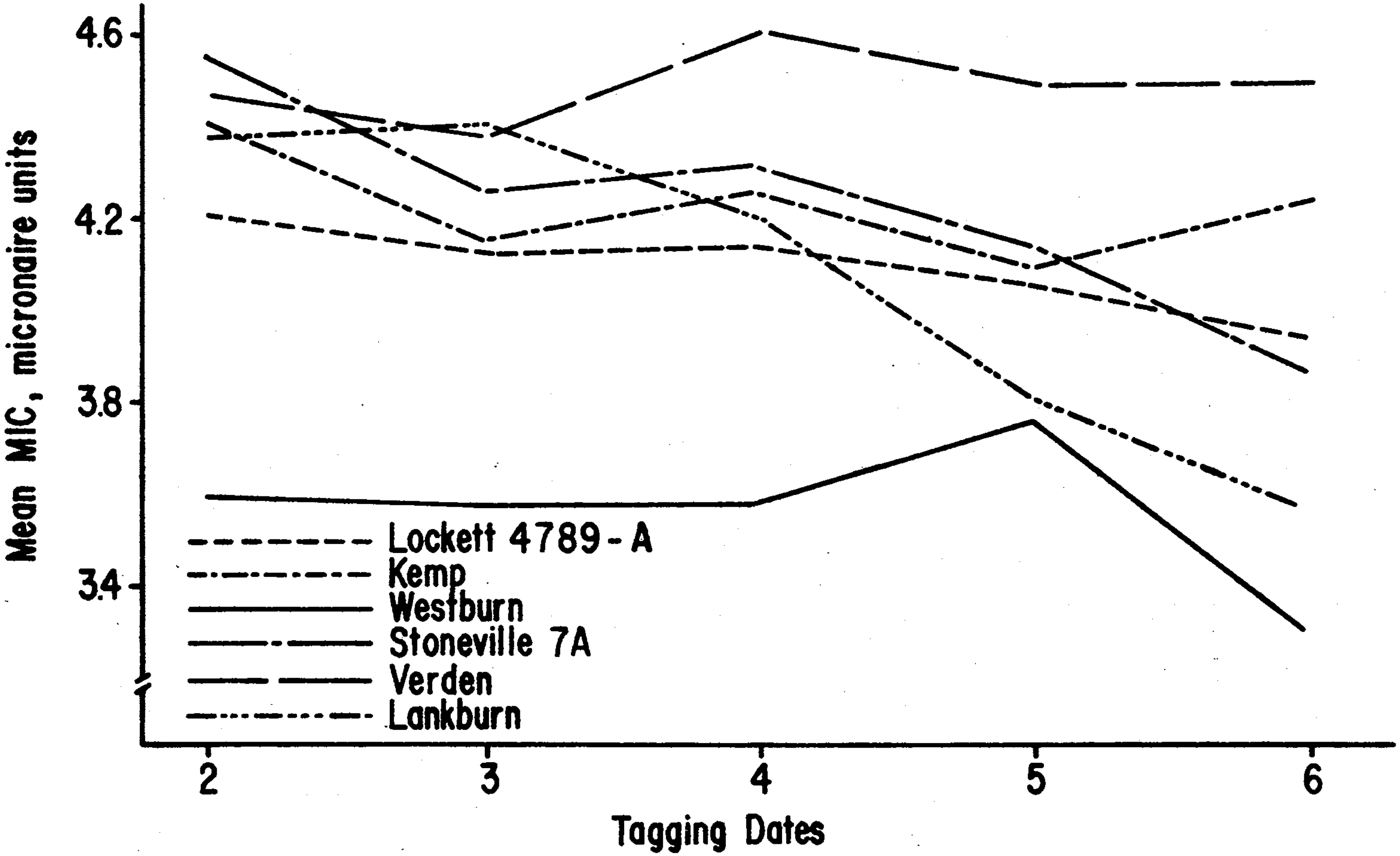

Figure 25. Mean Performance Over Years for MIC by Varieties and Tagging Dates

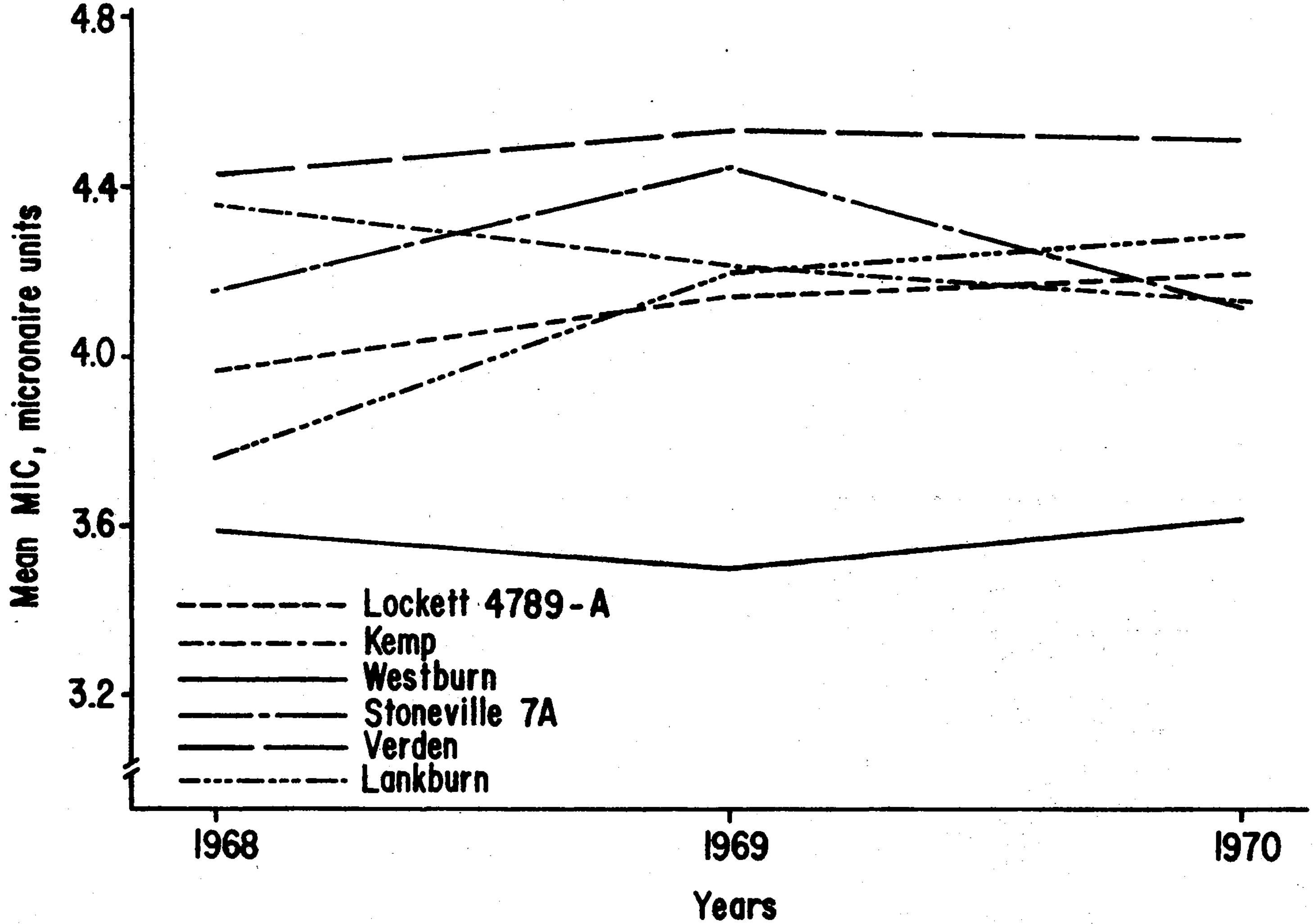

Figure 26. Mean Performance Over Tagging Dates for MIC by Years and Varieties

CHAPTER V

SUMMARY AND CONCLUSIONS

Six commercial varieties of upland cotton, Gossypium hirsutum L., were used to study the effect of blooming date on the retention and fiber properties of bolls. The experiment was conducted for three years (1968 through 1970) at a single location (Perkins, Oklahoma). Flowers were tagged at weekly intervals throughout each blooming season; and after frost, the bolls which developed from the tagged blooms were harvested by tagging dates on each row in each plot. Records were kept of the blooms tagged/row, tagged bolls set/row, and percent tagged bolls set/row at each tagging date. Fiber properties (2.5% span length, 50% span length, uniformity index, 1/8-inch gauge stelometer, and micronaire) were also studied to determine if general patterns of variation could be detected over tagging dates.

The conclusions derived from this study may be briefly summarized as follows:

Number of blooms tagged, NBT, increased from the beginning of the season until mid-season, then declined. The mean curve for NBT over the season exhibited a symmetrical distribution. Significant differences were detected for years, varieties, dates, and all possible interactions among them. Westburn exhibited the highest mean NBT over the season except for the last date; Lockett 4789-A peaked early in the season, then fell sharply. Stoneville 7A performed well the last part of the season. Verden was the poorest overall variety for this character particularly at the intermediate dates.

Number of bolls set, NBS, increased rapidly during the first third of the season; and after that, gradually decreased. The mean distribution for NBS over the season is similar in form to that for NBT particularly in the first part of the season. NBS declines more rapidly than does NBT, and the two distributions become more unlike as the season progresses. Significant differences in NBS were detected for all main effects and interactions except for the year X variety mean square. Lockett 4789-A, Westburn, and Stoneville 7A gave the highest performance for NBS in the first half of the season; but the first two varieties rapidly declined while Stoneville 7A persisted at a high level for a longer period of time, thereby, setting more total bolls. Verden performed poorly for NBS particularly in the first half of the season.

Percentage bolls set, PBS, was higher at the first date studied; then showed a more-or-less continuous decrease to the end of the season. The amount of shedding increases as the end of the season nears. Apparently, the cotton plant increases in efficiency of boll retention when the number of blooms are limited. Significant differences were noted for all sources of variation except for the year X location mean square. Stoneville 7A and Kemp performed well for this character with Lockett 4789-A doing almost as well. Westburn was the lowest in PBS at all except one date.

2.5% span length, 2.5% SL, exhibited different distribution over varieties in each of the three years. However, the distributions decreased fairly steadily particularly during the latter part of the season. Significant differences were detected for all sources of variation except the year mean square and the second-order interaction. Stoneville 7A had the longest 2.5% SL, followed by Lockett 4789-A and Lankburn, followed by Verden, then Westburn, then Kemp.

50% span length, 50% SL, distributions over varieties were in general very similar to those for 2.5% SL. Significant differences were obtained for all factors and combinations of factors except the three-factor interaction. Verden displayed the highest overall 50% SL, Lockett 4789-A was second, and Stoneville 7A (the variety with the longest 2.5% SL) came in third. Westburn in general had the shortest 50% SL.

Uniformity index, UNIF, was higher at the end of the season than it was in the middle of the season; and in two out of three years, it was also higher at the start than in the middle. Significant differences were found for all sources of variation except the year X variety mean square. Among the varieties in question, Verden had the most uniform fiber followed in order by Kemp, Lockett 4789-A, and Westburn. Stoneville 7A and Lankburn were the lowest, but it should be noted that they were two of the three highest in 2.5% SL.

1/8-inch gauge stelometer, T_1, over years and varieties tended to decline from the first to the last of the season. This trend, is more pronounced from the middle of the season to the end. Significant differences were not found only for the year X variety mean square. Lockett 4789-A exhibited the strongest fiber, followed by Westburn and Verden, followed by Stoneville 7A and Lankburn, followed by Kemp.

Micronaire, MIC, displayed considerably different curves over varieties between years and tagging dates preventing the discernment of any clear-cut patterns. However, it can be stated that all varieties except Verden displayed finer fibers at the end of the season than at the start. All sources of variation were significant for MIC except the year mean square. Verden displayed the coarsest fiber while Westburn exhibited the finest.

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APPENDIX

TABLE IV

MEAN RESPONSE OF EACH VARIETY FOR NBT BY TAGGING DATES IN EACH YEAR

Year and Variety	Tagging Dates					
	2	3	4	5	6	7
<u>1968</u>						
Lockett 4789-A	27.9	40.9	29.6	42.4	30.3	20.8
Kemp	7.6	11.9	13.3	54.3	32.4	21.3
Westburn	29.4	47.0	39.8	93.1	44.0	30.1
Stoneville 7A	14.0	31.1	24.8	79.8	33.1	33.4
Verden	15.5	22.6	27.1	59.1	28.3	19.4
Lankburn	10.6	21.6	22.5	77.5	30.6	17.4
<u>1969</u>						
Lockett 4789-A	29.0	51.6	63.4	47.1	42.8	15.9
Kemp	12.6	30.4	42.0	40.1	60.5	30.1
Westburn	28.9	52.3	74.8	74.9	89.8	29.9
Stoneville 7A	9.3	38.1	58.4	57.6	84.0	41.3
Verden	10.6	23.5	39.3	31.4	55.1	29.1
Lankburn	12.1	36.3	58.5	52.1	54.9	15.9
<u>1970</u>						
Lockett 4789-A	27.4	78.3	62.0	38.8	11.9	16.6
Kemp	24.8	68.1	63.3	54.6	21.5	10.4
Westburn	31.5	89.8	71.1	50.5	14.6	11.5
Stoneville 7A	26.3	91.6	82.5	72.4	19.5	15.1
Verden	14.1	48.8	56.6	57.6	21.6	13.8
Lankburn	9.6	37.9	42.9	42.9	22.4	13.4

TABLE V

MEAN RESPONSE OF EACH VARIETY FOR NBS BY TAGGING DATES IN EACH YEAR

Year and Variety	Tagging Dates					
	2	3	4	5	6	7
1968						
Lockett 4789-A	20.4	24.8	17.6	17.5	7.6	3.1
Kemp	5.6	7.8	6.4	29.0	9.8	1.5
Westburn	16.9	22.4	18.4	21.3	4.0	0.8
Stoneville 7A	10.6	13.3	15.6	37.5	7.9	4.9
Verden	9.3	7.9	14.1	25.4	8.5	1.5
Lankburn	7.0	11.1	12.5	26.9	3.6	1.0
1969						
Lockett 4789-A	25.4	32.8	28.1	18.8	7.8	0.6
Kemp	11.4	22.4	27.4	17.0	11.8	1.9
Westburn	23.4	29.6	35.5	16.9	8.1	0.9
Stoneville 7A	8.3	28.3	44.6	33.3	15.4	2.4
Verden	8.4	14.4	25.3	17.1	16.3	2.3
Lankburn	10.5	25.4	27.9	20.5	7.0	0.5
1970						
Lockett 4789-A	21.5	54.1	13.9	5.8	2.9	2.1
Kemp	20.4	43.4	11.5	8.0	3.5	0.3
Westburn	22.0	44.3	9.0	6.0	2.6	0.0
Stoneville 7A	21.0	60.5	19.9	9.4	6.0	1.4
Verden	11.5	26.4	4.3	8.1	7.1	1.4
Lankburn	8.0	25.8	8.8	8.0	3.3	0.3

TABLE VI

MEAN RESPONSE OF EACH VARIETY FOR PBS BY TAGGING DATES IN EACH YEAR

Year and Variety	Tagging Dates					
	2	3	4	5	6	7
1968						
Lockett 4789-A	71.2	59.8	57.9	42.7	24.7	15.2
Kemp	61.9	71.0	51.1	51.8	30.0	7.5
Westburn	61.8	47.6	46.1	24.2	9.6	1.9
Stoneville 7A	74.5	42.7	65.9	46.8	23.8	15.4
Verden	60.4	31.8	50.7	40.9	30.0	7.1
Lankburn	64.5	51.0	57.6	32.8	11.6	8.6
1969						
Lockett 4789-A	86.2	64.0	45.8	40.7	20.5	4.5
Kemp	90.0	74.8	67.5	42.7	18.4	5.5
Westburn	81.6	57.7	50.7	24.1	8.7	4.2
Stoneville 7A	85.7	74.0	77.1	58.2	22.1	4.7
Verden	78.7	62.1	66.0	52.5	28.8	7.0
Lankburn	85.2	70.0	49.5	39.3	13.2	3.4
1970						
Lockett 4789-A	77.3	69.4	22.7	15.9	22.2	10.2
Kemp	82.4	63.6	19.8	14.2	23.4	2.4
Westburn	69.2	50.0	13.9	12.8	18.0	0.0
Stoneville 7A	80.1	66.3	26.0	12.1	32.6	8.3
Verden	82.0	55.6	6.9	15.3	32.4	7.8
Lankburn	84.9	68.0	19.8	20.1	19.5	1.7

TABLE VII

MEAN RESPONSE OF EACH VARIETY FOR 2.5% SL
BY TAGGING DATES IN EACH YEAR

Year and Variety	Tagging Dates				
	2	3	4	5	6
1968					
Lockett 4789-A	1.102	1.004	1.057	1.016	0.968
Kemp	1.107	0.981	1.013	0.972	0.887
Westburn	1.062	0.969	0.998	0.950	0.895
Stoneville 7A	1.130	1.048	1.076	1.030	0.968
Verden	1.068	0.967	0.973	0.952	0.882
Lankburn	1.108	1.002	1.042	0.991	0.953
1969					
Lockett 4789-A	1.029	1.050	1.075	1.057	0.977
Kemp	0.931	0.981	0.987	0.955	0.895
Westburn	0.993	0.997	1.016	0.987	0.944
Stoneville 7A	1.081	1.121	1.123	1.085	1.011
Verden	0.999	1.007	1.046	1.026	0.942
Lankburn	1.045	1.068	1.098	1.029	1.002
1970					
Lockett 4789-A	1.066	1.083	0.999	0.938	0.940
Kemp	0.988	0.997	0.911	0.863	0.852
Westburn	1.014	1.006	0.907	0.875	0.934
Stoneville 7A	1.085	1.083	0.994	0.945	0.950
Verden	1.028	1.042	0.944	0.903	0.924
Lankburn	1.073	1.082	1.011	0.933	0.998

TABLE VIII

MEAN RESPONSE OF EACH VARIETY FOR 50% SL
BY TAGGING DATES IN EACH YEAR

Year and Variety	Tagging Dates				
	2	3	4	5	6
<u>1968</u>					
Lockett 4789-A	0.512	0.487	0.500	0.480	0.458
Kemp	0.492	0.474	0.499	0.475	0.438
Westburn	0.489	0.456	0.473	0.451	0.429
Stoneville 7A	0.517	0.476	0.511	0.478	0.460
Verden	0.527	0.483	0.490	0.472	0.450
Lankburn	0.494	0.453	0.467	0.439	0.437
<u>1969</u>					
Lockett 4789-A	0.500	0.513	0.512	0.483	0.452
Kemp	0.463	0.497	0.480	0.446	0.430
Westburn	0.475	0.463	0.456	0.441	0.444
Stoneville 7A	0.497	0.523	0.513	0.481	0.469
Verden	0.509	0.523	0.536	0.497	0.480
Lankburn	0.498	0.496	0.512	0.429	0.459
<u>1970</u>					
Lockett 4789-A	0.496	0.473	0.439	0.448	0.451
Kemp	0.463	0.432	0.405	0.412	0.409
Westburn	0.449	0.425	0.394	0.410	0.418
Stoneville 7A	0.478	0.443	0.421	0.429	0.436
Verden	0.495	0.479	0.439	0.452	0.455
Lankburn	0.471	0.459	0.436	0.428	0.437

TABLE IX

MEAN RESPONSE OF EACH VARIETY FOR UNIF BY TAGGING DATES IN EACH YEAR

Year and Variety	Tagging Dates				
	2	3	4	5	6
1968					
Lockett 4789-A	46.5	48.5	47.3	47.2	47.2
Kemp	48.3	48.4	49.3	48.8	49.5
Westburn	46.0	47.1	47.4	47.5	48.0
Stoneville 7A	45.7	45.4	47.5	46.4	47.5
Verden	49.3	50.0	50.4	49.7	51.1
Lankburn	44.6	45.2	44.8	44.3	45.9
1969					
Lockett 4789-A	48.5	48.9	47.6	45.7	46.3
Kemp	49.7	50.6	48.6	46.7	48.1
Westburn	47.8	46.4	44.9	44.7	47.0
Stoneville 7A	46.0	46.6	45.7	44.3	46.5
Verden	51.0	51.9	50.4	48.4	50.9
Lankburn	47.6	46.4	46.6	41.6	45.8
1970					
Lockett 4789-A	46.5	43.7	43.9	47.8	48.0
Kemp	46.8	43.3	44.4	47.8	48.0
Westburn	44.3	42.2	43.5	46.8	44.8
Stoneville 7A	44.1	41.0	42.4	45.5	46.1
Verden	48.1	46.0	46.5	50.0	49.3
Lankburn	43.9	42.4	43.1	45.9	43.8

TABLE X

MEAN RESPONSE OF EACH VARIETY FOR T_1 BY TAGGING DATES IN EACH YEAR

Year and Variety	Tagging Dates				
	2	3	4	5	6
1968					
Lockett 4789-A	2.19	2.06	2.26	2.15	2.14
Kemp	1.90	1.88	2.00	1.79	1.71
Westburn	2.02	1.90	2.09	1.97	1.95
Stoneville 7A	2.00	1.81	2.05	1.82	1.82
Verden	2.13	2.01	2.17	1.93	1.84
Lankburn	2.03	1.88	2.05	1.84	1.94
1969					
Lockett 4789-A	2.13	2.18	2.17	2.25	1.92
Kemp	1.92	1.99	1.82	1.91	1.75
Westburn	2.15	2.05	2.14	2.10	1.98
Stoneville 7A	2.14	2.19	2.11	2.09	1.84
Verden	2.08	2.10	2.01	2.15	1.75
Lankburn	1.97	1.93	1.95	1.88	1.79
1970					
Lockett 4789-A	2.00	1.83	1.98	1.98	1.91
Kemp	1.84	1.66	1.70	1.75	1.68
Westburn	1.98	1.84	1.93	1.72	1.84
Stoneville 7A	1.84	1.68	1.69	1.69	1.68
Verden	1.81	1.79	1.86	1.93	1.80
Lankburn	1.87	1.83	1.94	1.64	1.81

TABLE XI

MEAN RESPONSE OF EACH VARIETY FOR MIC
BY TAGGING DATES IN EACH YEAR

Year and Variety	Tagging Dates				
	2	3	4	5	6
1968					
Lockett 4789-A	4.1	4.5	4.1	4.0	3.2
Kemp	4.5	4.6	4.4	4.5	3.9
Westburn	3.4	4.1	3.9	3.9	2.8
Stoneville 7A	4.4	4.4	4.4	4.2	3.4
Verden	4.5	4.6	4.4	4.4	4.3
Lankburn	4.1	4.3	3.6	3.6	3.2
1969					
Lockett 4789-A	4.4	4.2	4.4	3.5	4.4
Kemp	4.7	4.4	4.6	3.5	4.1
Westburn	3.8	3.5	3.4	3.0	3.9
Stoneville 7A	4.9	4.6	4.7	3.7	4.5
Verden	4.8	4.4	4.7	4.0	4.9
Lankburn	4.9	4.6	4.6	3.1	4.0
1970					
Lockett 4789-A	4.2	3.8	4.0	4.8	4.3
Kemp	4.1	3.6	3.9	4.4	4.8
Westburn	3.6	3.3	3.6	4.5	3.3
Stoneville 7A	4.4	3.8	4.0	4.6	3.9
Verden	4.2	4.2	4.8	5.1	4.4
Lankburn	4.2	4.4	4.5	4.8	3.6

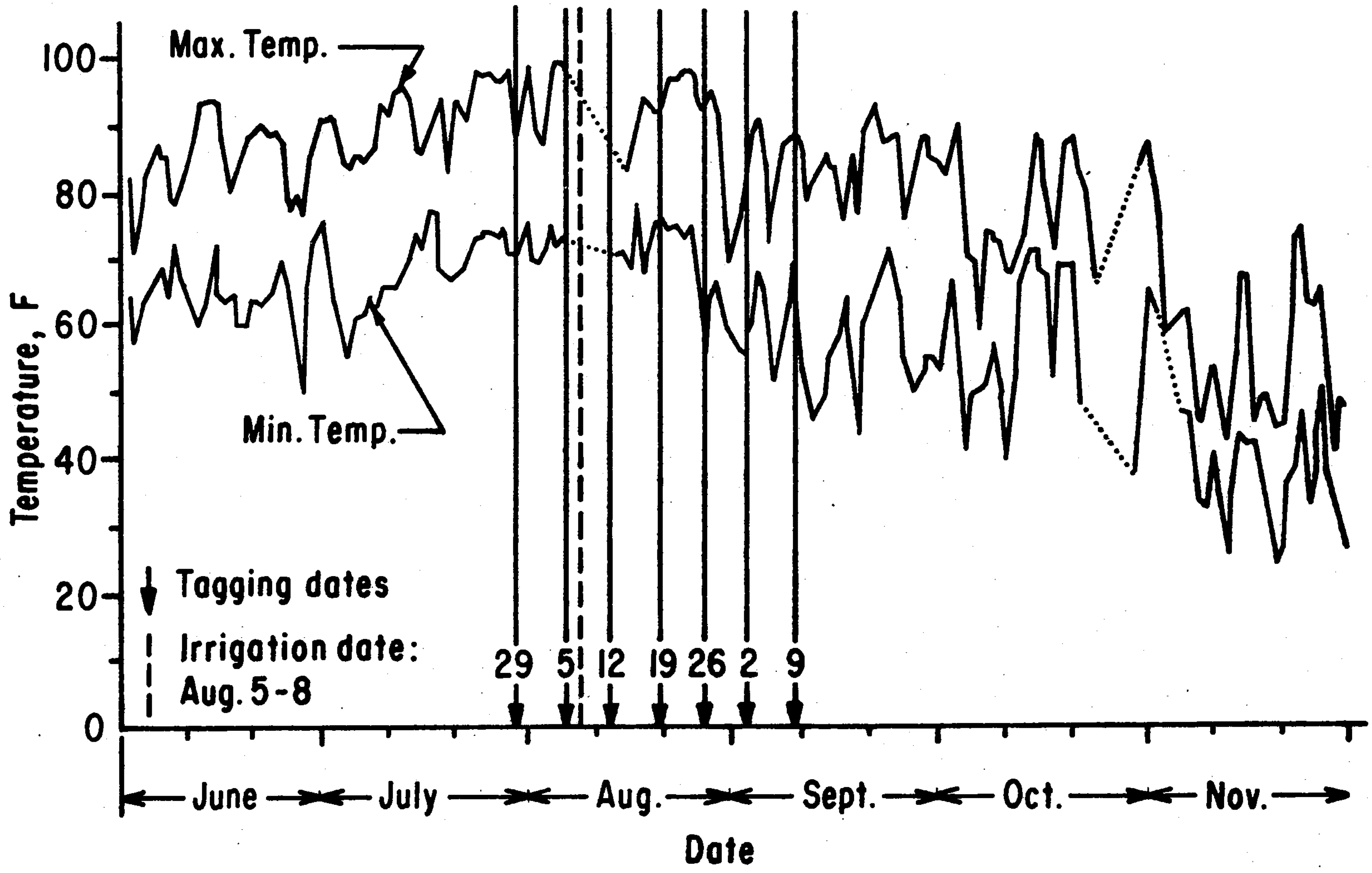

Figure 27. Daily Maximum and Minimum Temperature from June through November, 1968, Perkins, Okla.

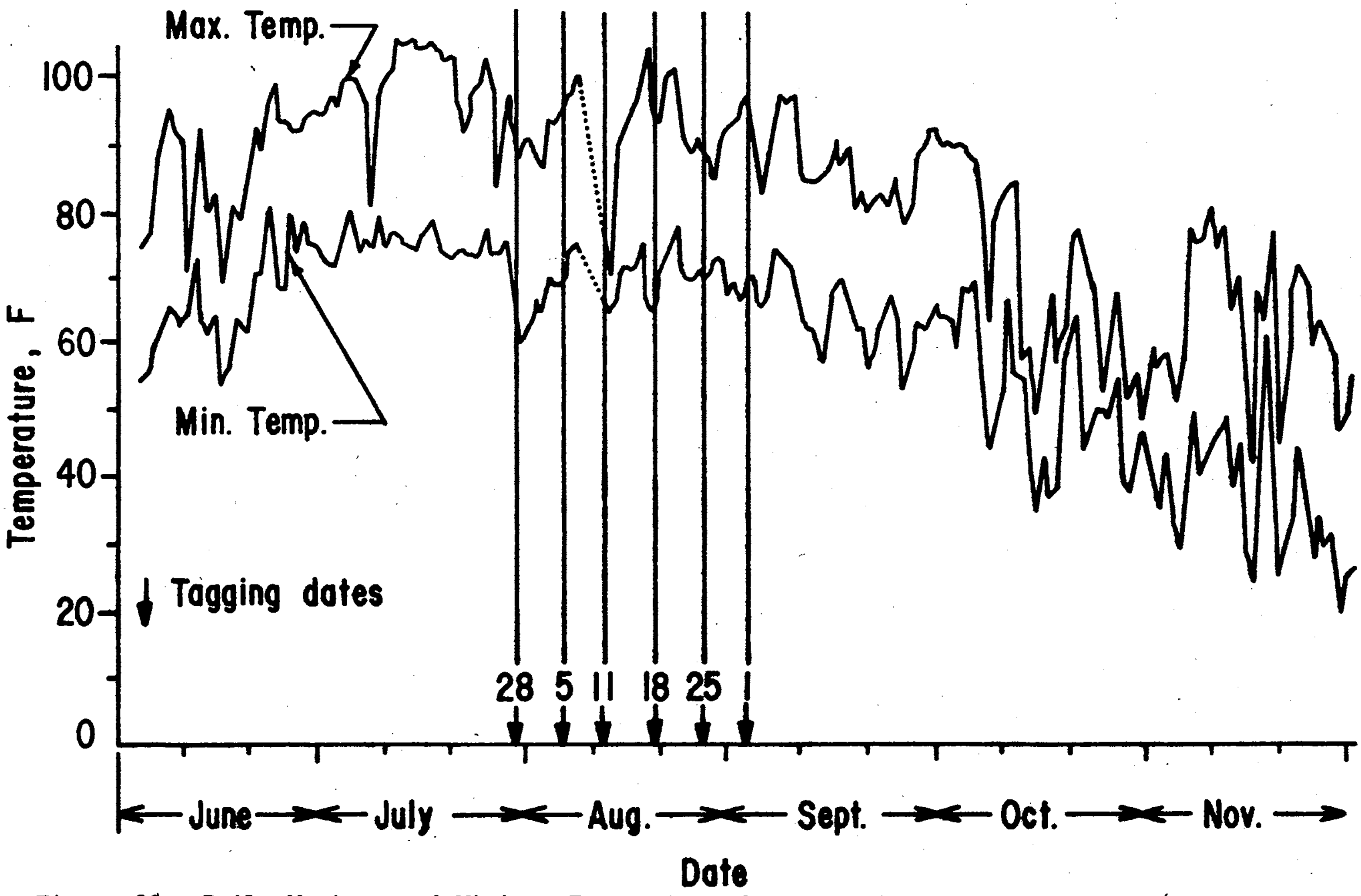

Figure 28. Daily Maximum and Minimum Temperature from June through November, 1969, Perkins, Okla.

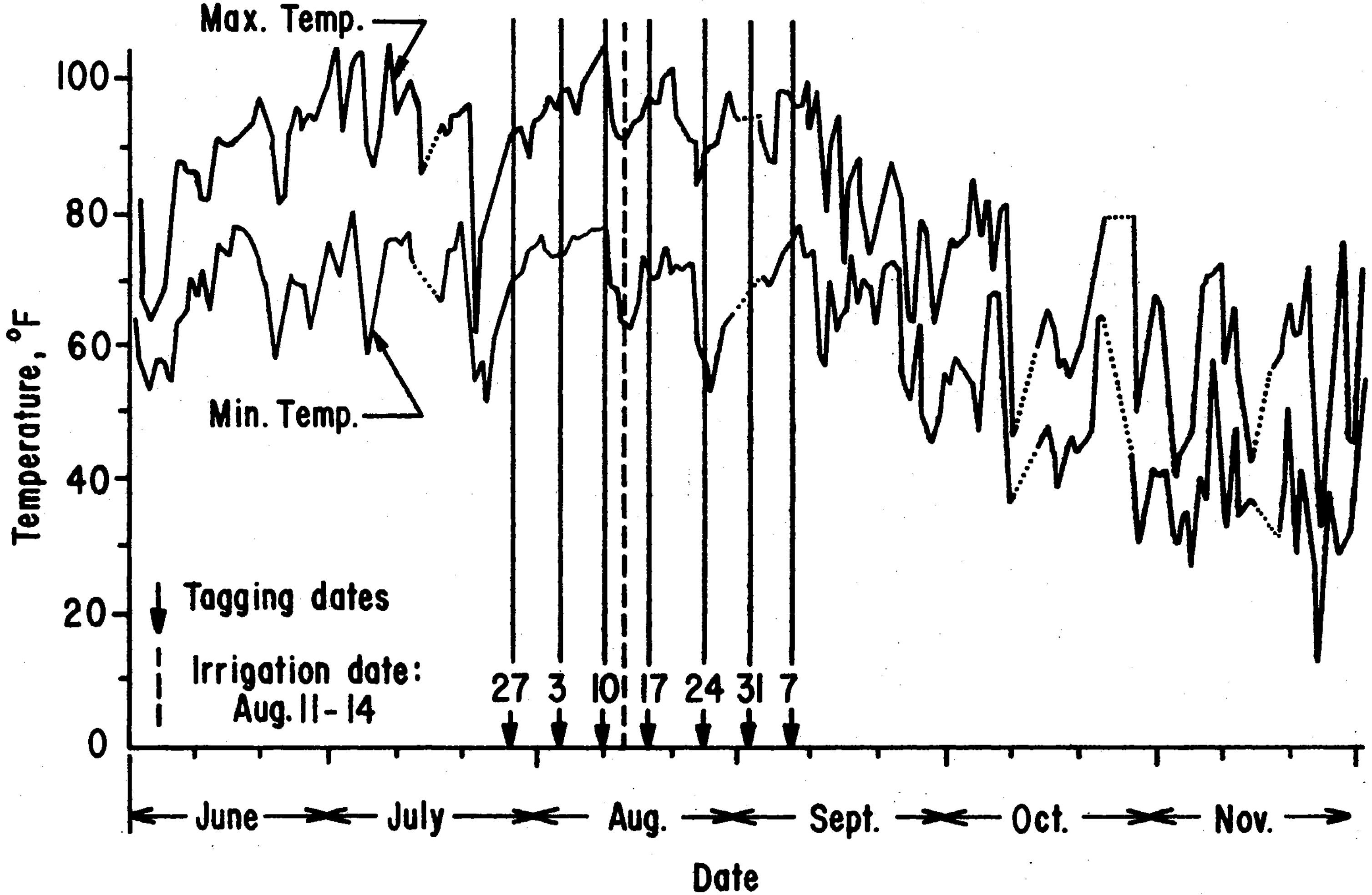

Figure 29. Daily Maximum and Minimum Temperature from June through November, 1970, Perkins, Okla.

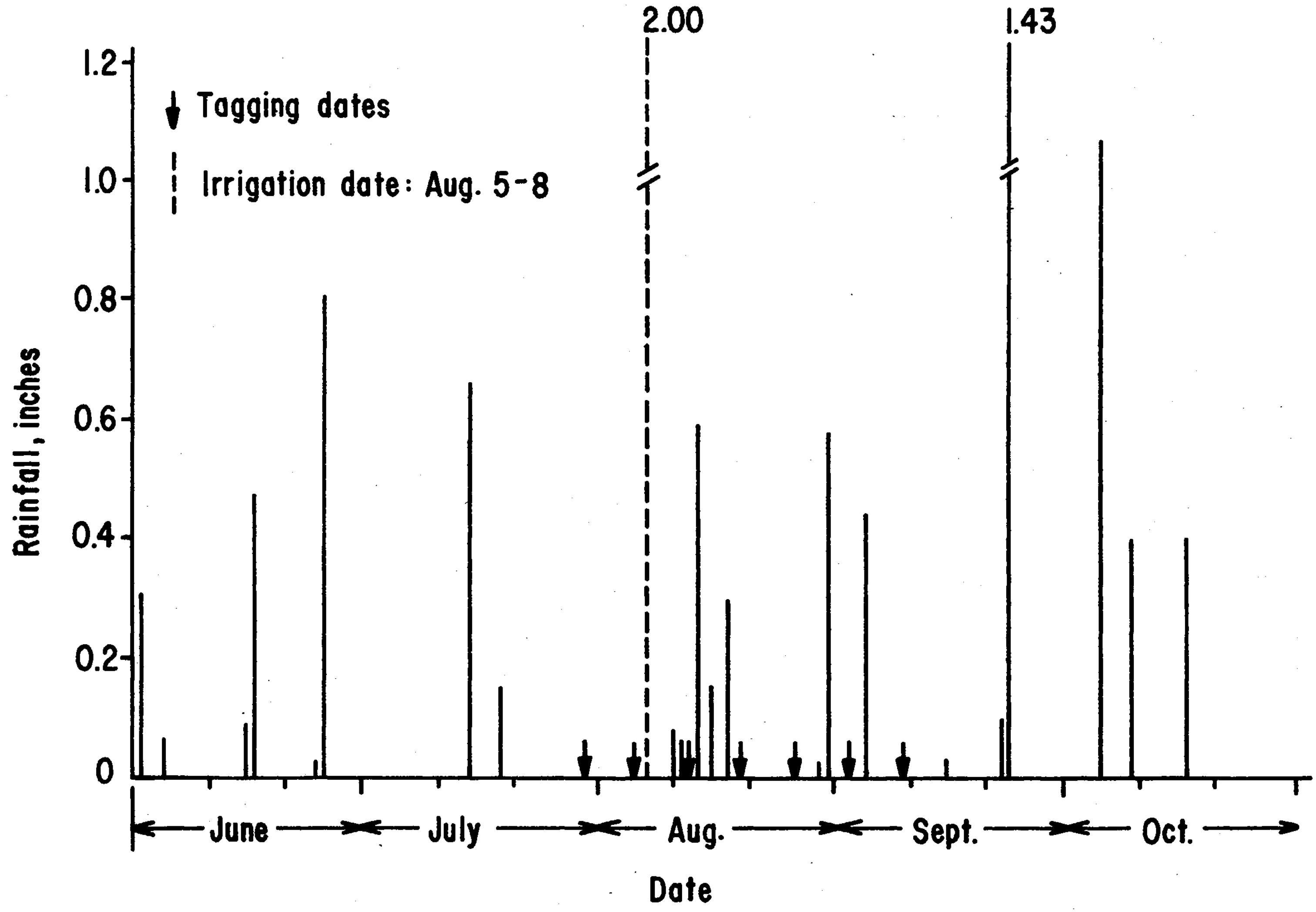

Figure 30. Daily Rainfall Records for 1968 at Perkins, Okla.

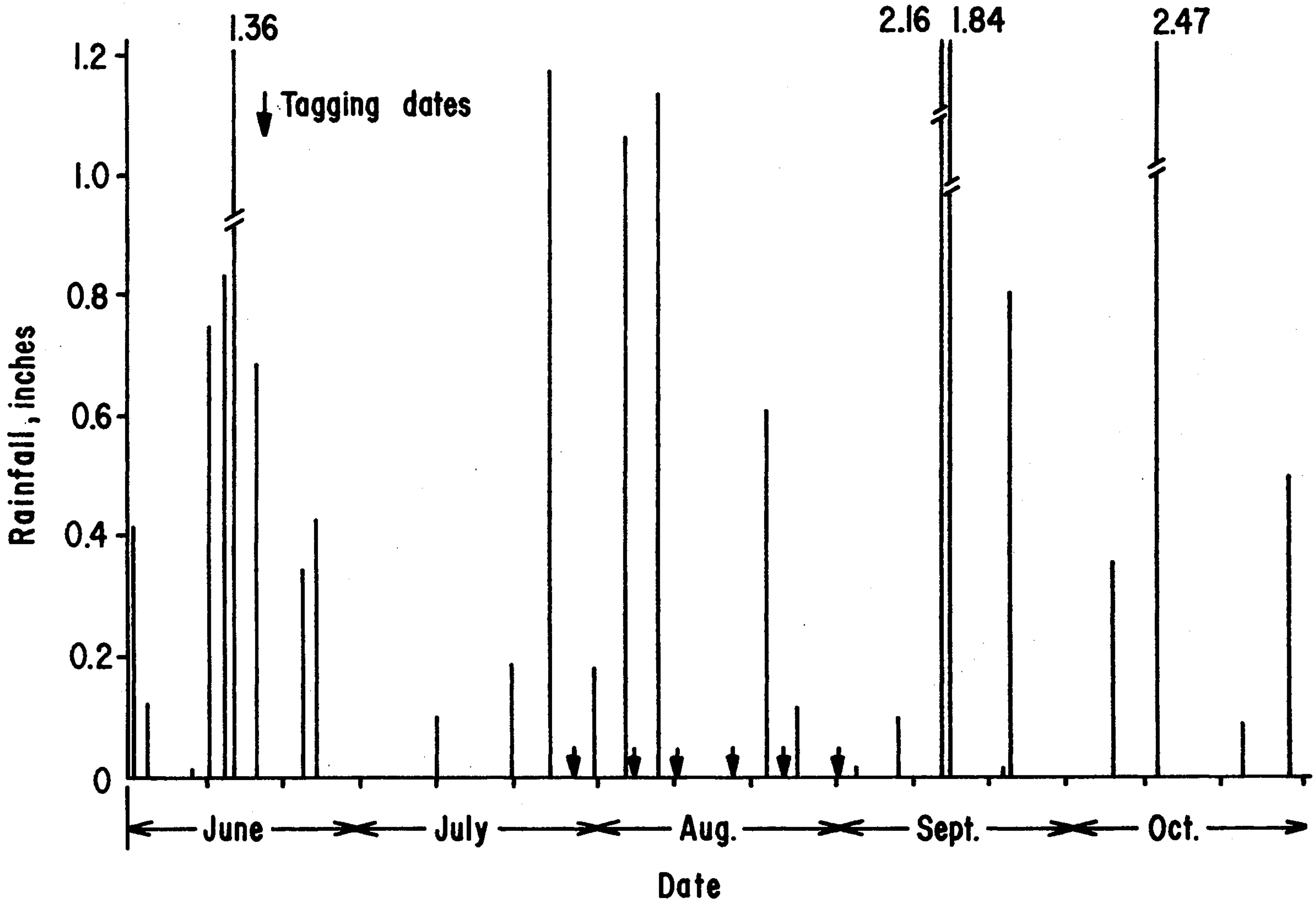

Figure 31. Daily Rainfall Records for 1969 at Perkins, Okla.

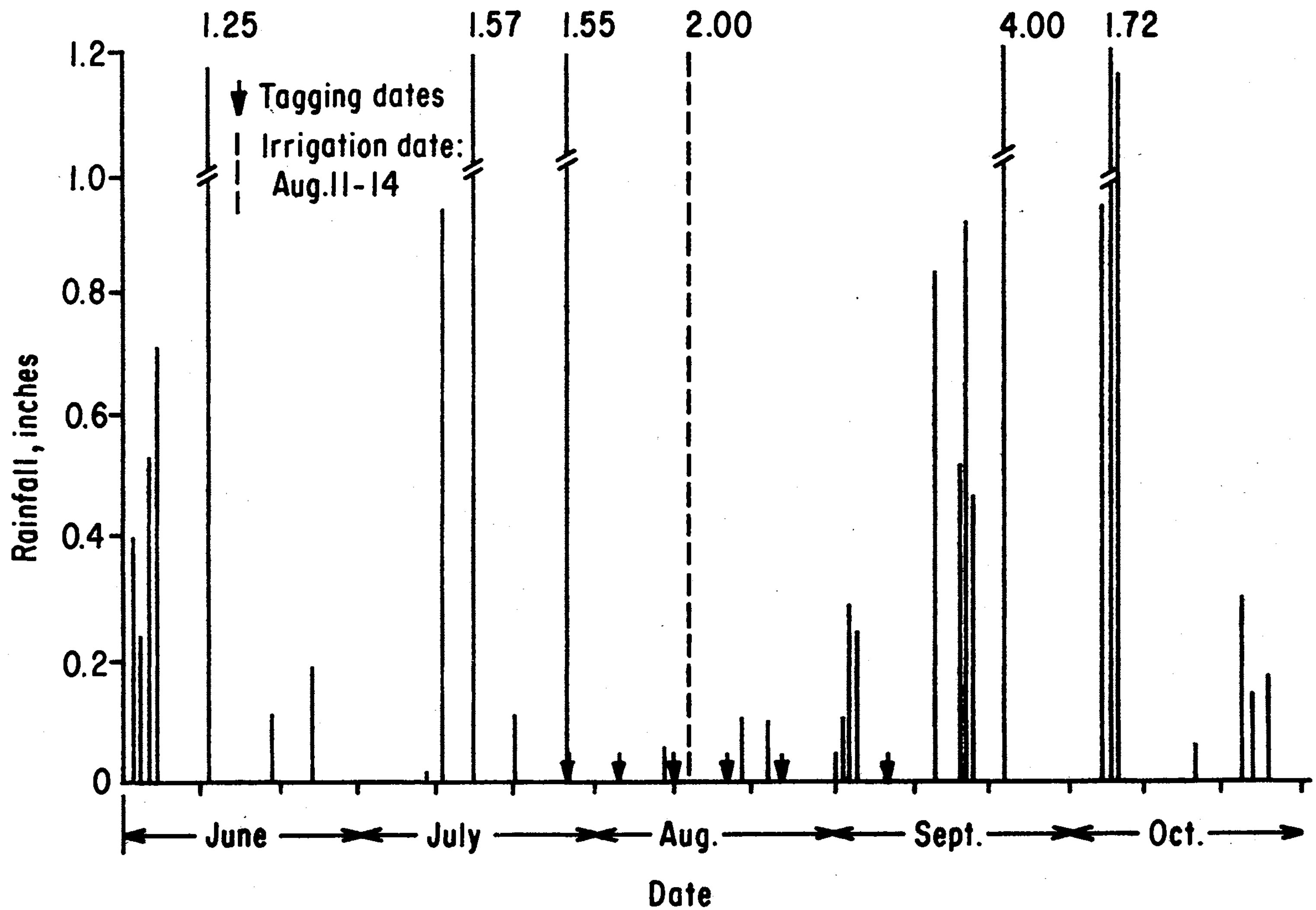

Figure 32. Daily Rainfall Records for 1970 at Perkins, Okla.

VITA

Reza Mamaghani

Candidate for the Degree of

Master of Science

Thesis: THE EFFECT OF BLOOMING DATE ON THE RETENTION AND FIBER PROPERTIES OF BOLLS IN SIX VARIETIES OF COTTON, GOSSYPIUM HIRSUTUM L.

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